Periodiek mondonderzoek

De mondgezondheid van de Nederlandse bevolking is in de afgelopen decennia aanzienlijk verbeterd. Niet iedereen gaat meer gebukt onder het ongemak van veel gaatjes, tandvleesontstekingen en onaangename tandheelkundige behandelingen. De motivatie om een gezond gebit te bezitten is toegenomen en de preventie heeft voor een groot aantal mensen zijn vruchten afgeworpen.

Het periodieke mondonderzoek (voorheen "halfjaarlijkse controle") is nu voor 80% van de bevolking een vanzelfsprekendheid. Gaatjes en tandvleesproblemen komen echter in de bevolking nog wel voor.

Er is zelfs sprake van een ongelijke verdeling: mensen met geen of nauwelijks mondziekten en zij die regelmatig nieuwe mond- en tandziekten ontwikkelen.

Deze individuele verschillen worden meer zichtbaar en vragen om een andere aanpak van het periodieke mondonderzoek. Een vaste controletermijn (van veelal 6 maanden) voor iedereen is uit oogpunt van goede zorgverlening niet meer passend. Inmiddels zijn er wetenschappelijke aanzetten gedaan tot een meer op het individu gerichte benadering van het periodieke mondonderzoek. Daarbij is vooral de ernst van de aanwezige ziekte(n) bij een persoon richtinggevend voor de inhoud van het onderzoek en voor de bepaling van de termijn tot het volgend onderzoek.

Dit proefschrift inventariseert meningen van tandartsen en regelmatige tandartsbezoekers, onderzoekt het handelen in de praktijk van alledag, zoekt en bundelt het bewijs uit wetenschappelijk onderzoek en presenteert ontwikkelde instrumenten met betrekking tot de invoering van vernieuwingen voor de opleiding tot tandarts en de tandheelkundige beroepsuitoefening.

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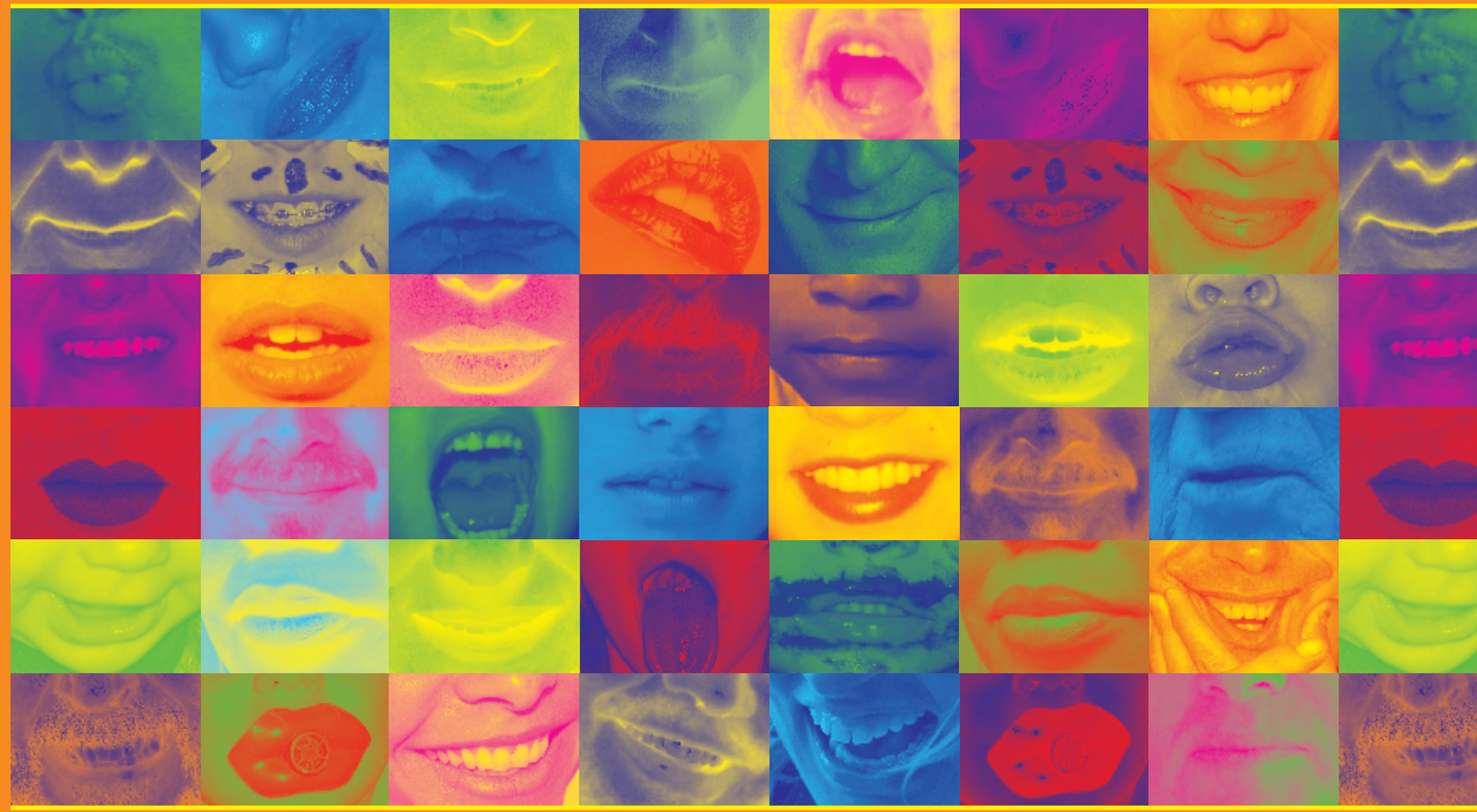

CENTRE FOR QUALITY OF CARE RESEARCH

Dirk Mettes

Dirk Mettes

In herinnering aan mijn ouders

Gerrit Mettes
Johanna van Mierlo

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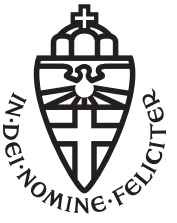

Routine oral examination:
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Proefschrift

Een wetenschappelijke proeve
op het gebied van de Medische Wetenschappen

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volgens het besluit van het College van Decanen
in het openbaar te verdedigen op vrijdag 13 juni 2008
om 12.00 uur precies
door

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Contents

General introduction

Introduction

For decades, routine oral examination (ROE), well known as '6-monthly check-ups', focussed on the detection of dental caries, which was highly prevalent in The Netherlands. Attending dental practice for ROE has been strongly embedded in the Dutch health care system. A majority of the Dutch population is attending regularly general dental practice, mostly twice a year. In 2006, the total number of ROEs conducted in general dental practice exceeded 17 million (1). There is an ongoing debate about the appropriate use of ROEs and recall intervals, leading to a demand for new strategies suitable for both patients and professionals. To provide guidance on how to implement best evidence in general dental practice, research on quality of oral health care delivery is needed (2).

This thesis aims to explore content and frequency of ROE in daily dental practice, related to the evidence base, and to what extent these aspects can improve clinical performance of general dental practitioners (GDPs). The main research question is how a patient-centred ROE can be implemented in general dental practice.

History of ROEs in primary care

In The Netherlands, from 1948 until the reform of the National Health care system in 1995, two ROEs a year were compulsory for all public health care insured people as a requirement for reimbursement of costs for dental treatment (3). The rationale for implementing this collective system was to promote regular dental attendance, since the dentist was seen as the most appropriate professional to detect oral diseases, and to prevent onset or further progression.

In the first decades after the Second World War, the epidemic nature of dental caries in the Dutch population, together with a relative shortage of oral care providers, resulted mainly in emergency interventions to prevent and resolve pain and discomfort. Priorities were given to restorative and surgical rather than preventive interventions.

In the late sixties of the last century, a growing interest in preventive dentistry, especially focused on dental caries occurred. During several decades, the combination of several preventive measures and public oral health education and promotion campaigns (so called TGVO) resulted in improved oral health compliance and regular dental practice visits (4-7). In 1981, 60% of the Dutch population regularly visited the dentist for ROE, and by 1998 this percentage had increased to 80% (8). Due to all these achievements, the prevalence of oral diseases (mainly dental caries) decreased substantially and the percentage of edentulous patients older than sixty years of age decreased between 1981 and 2002 from 32% to 14 % (8-10).

In general dental practice, ROEs are in most cases performed by general dental practitioners (11). Nevertheless, in a growing number of practices GDPs are working in cooperation with peers, dental hygienists and oral health care-related team workers. Delegation of specific preventive and operative interventions is becoming reality in daily practice (12).

Recall intervals and oral health

Regular or asymptomatic-driven attendance patterns are characterised by the type of recall interval. A recall interval refers to the period between two consecutive ROEs, which can be either

fixed or individualised. A fixed recall interval is the same period of time for all patients between successive ROEs, whereas an individualised or variable recall interval varies among patients and is based on the assessment of individual risk for disease. In the Netherlands, for decades a fixed interval of six months was common practice.
However, assigned recall intervals of six months for all patients, are not based on solid evidence (13). Studies suggested that dental caries risk did not increase when extending the recall interval (14-16). Based on caries risk in young patients, GDPs showed a substantial variation in assigning recall intervals (range 3-36 months) between successive ROEs (17). A five-year study on the effect of different recall periods (3, 6, 12 and 18 months) on periodontal disease progression (bleeding scores, pocket depth and attachment loss) concluded that a recall period of once a year for individuals with low susceptibility for periodontal disease was appropriate, whereas subjects with elevated plaque- and bleeding scores would benefit from shorter recall intervals (18).
Optimal oral health represents a disease-, pain-free condition of hard and soft dental tissues as well as oral mucosa within the oral cavity, supplied by good quality saliva, thus allowing an individual to function physically, socially and emotionally without discomfort. To monitor oral health and maintain a healthy oral condition, regularly attending dental practice aims to improve general health status and as a result quality of life.
Within the health care system in The Netherlands, regular attending dental practice is an essential component in promoting oral health, i.e. prevention of dental caries and periodontal disease (19). Prevention of oral diseases (mainly dental caries) in The Netherlands showed to be effective (20-22). Improvement of oral health has resulted in a change in practice in the spectrum of regular attendees in the direction of an increasing number of elderly people (still in the possession of their natural teeth) claiming appropriate oral health maintenance and prevention (23). Consequently, the nature and function of ROE has changed over time. The majority of regular attendees represent relatively healthy, disease-free individuals, frequently and voluntarily scheduled for ROE. From this point of view, ROE focusses mainly on preventive aspects and early detection of various oral diseases, and as such can be considered to be the cornerstone of effective and individual oral care delivery (24, 25). Therefore, questions arise about the appropriate content of a ROE and how this should be related to the assignment of individual recall intervals. It has not been assessed yet how GDPs currently make decisions concerning regular attending patients in primary oral care and how cost-effective ROEs are in preventing oral disease. More knowledge concerning patient-, practice- and GDPs characteristics influencing clinical behaviour is needed to identify performance gaps and potential barriers for improvement.

Female patients as well as patients who are more satisfied with their teeth have stronger preferences for attending dental practice regularly than male patients and patients who are less satisfied with their teeth (26, 27). Socio-economic factors are suggested to have an impact on regular attendance in general dental practice (8, 28, 29). Attendance patterns are also influenced by patients' perceptions of the effect of oral health on quality of life (30).
Research does not provide straightforward evidence for a positive relation between regular den-

tal attendance and oral health (31-33). Regular attendees showed to have higher incidence of dental caries, and in receiving dental treatment, they reported to have more negative experiences (34-36). On the other hand, regular attendance was related to improved oral health, an increased number of 'functional' units in the oral cavity, and fewer untreated oral diseases (33-36). Recent studies reported regular attendees to have fewer teeth (37), but to experience significant less pain and discomfort (38, 39). Epidemiological data in The Netherlands suggest that the probability of having a sound dentition in adulthood increases if they in early childhood started to see the dentist regularly for ROEs (40, 41).

How Dutch patients experience regular oral screening in dental practice, and what expectations they have is unknown. From a quality of care perspective, patients' opinions and preferences should also be taken into account in determining appropriate intervals.

ROE and current decision making in clinical practice

As a consequence of the changing nature and function of ROEs, the decision-making process has now a more prominent role, and depends for the greater part on probabilities (42). The GDP should assess and monitor individual risk for various oral diseases in order to assign recall periods most appropriate to prevent disease onset or progression. The probability to make correct diagnosis and decisions, based on visual observations, concerning initial carious lesions, which are in general not fully documented is low (43). Additional radiographic diagnosis is needed to detect, and subsequently monitor small enamel- or dentinal lesions.

An appropriate recall interval assignment and bitewing frequency timing depend strongly on the individual risk for, and progression of oral disease. The predictive validity of diagnostic needs for caries and periodontal disease may be fair on a population level (44), yet on an individual level they are difficult to apply. The progression of oral disease does not only depend on individual risk factors (45) but is also influenced by the availability of manpower in oral care delivery (46), the characteristics of dentists and dental practices (47) and the variation in diagnostic performance (48). On a patient level, the diagnostic performance of GDPs is directly influenced by progression rates of various oral diseases as well as by the involvement of multiple risk factors causing a specific disease. Decisions to make at various individual assessments have to be re-assessed and documented every time a patient attends for a ROE with direct consequences for each assigned recall period. These decisions are for the greater part related to lesion progression for dental caries, periodontal disease, tooth wear, but also to oral cancer, the timing of additional radiographs, and risk management of developing wisdom teeth.

Nowadays, various decisions related to ROEs are not exclusively taken by GDPs only. The dental hygienist for instance can be held responsible for specific diagnostic ROE aspects, which is in fact in line with their described competences and the legislation under the Dutch BIG-law (1995). Therefore, criteria for appropriate content and use of various ROE items tailored to individual recall intervals are highly needed to assure shared decision-making between professionals. Up to now, research data describing the type and number of ROE screening items to be performed in patients with different risk for oral disease are not available, let alone which dental professional is best equipped to perform specific items.

A new strategy towards a patient-centred routine oral examination

The changing individual needs of various patient categories, the diversity of professional workers in general dental practice and the demands of society give rise to questions concerning the effective, efficient and acceptable use of ROEs (content and frequency) in patient care. Contemporary quality of care is directly related to the principles of evidence-based practice. Decisions regarding oral care of individual patients should be based on conscientious, judicious and explicit use of current best evidence (49). Systematic decisions like fixed recall intervals, fixed bitewing frequency prescription and systematic prophylactic removal of third molars should be based on both scientific and clinical evidence.

Risk is the probability of an event in a specific period of time (50). In health care, this implies that the probability of an individual to develop a specific disease or experiencing a health status change over a period of time is associated with specific factors (51). The risk of oral disease can be assessed by identifying and analysing all related factors, biological and behavioural (52). Selecting patients at risk for oral diseases could be an appropriate (effective) strategy in general dental practice, taking into account that individual disease onset/progression varies substantially and is only prevalent in specific susceptible groups of patients (35, 42, 53). Such a high-risk strategy seeks to protect susceptible individuals, while a population-based strategy intends to control the causes of incidence of diseases (54). The effectiveness of standard recall intervals in such a strategy

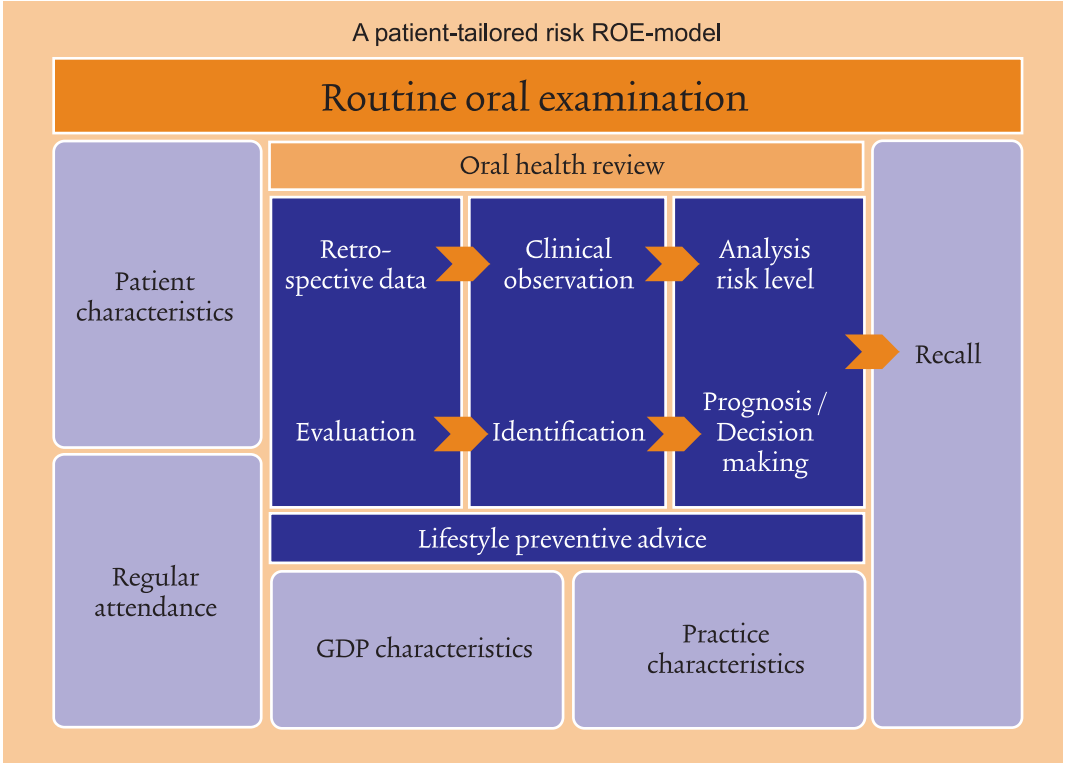

Figure 1. A patient-tailored risk ROE-model exploring the content and recall interval of ROEs in the context of patient, GDPs, and practice characteristics

is questionable, as many patients would get their ROE intervention too early, while others would be too late for an early intervention.

This thesis focusses on the changing individual needs of patients regarding ROEs as described above. One of the research questions is how a patient-tailored surveillance approach could be implemented in ROEs in general dental practice. Oral health is determined by diet, oral hygiene (dental plaque), smoking, alcohol use, stress and trauma. Oral diseases like dental caries, periodontal disease and tooth wear are of multifactorial causation. Multiple risk factors are common to a number of other chronic diseases mostly related to similar lifestyle aspects. A patient-tailored risk strategy based on a 'risk factor versus protective health factor' approach includes efforts to improve oral health by reducing risks (advice to cope with different risk factors) and promoting healthy behaviour. This thesis intends to explore content and frequencies aspects of risk-based ROEs related to the available scientific evidence. In Figure 1, a patient tailored risk model is conceptualised, the content (oral health review items) and particularly the recall interval of ROEs are explored in the context of clinically determined patient- and GDP- and practice characteristics. Therefore, data retrieved from the literature search (including the Cochrane review) will be used to underpin a patient-tailored clinical performance related to the evidence base.

Quality improvement

Quality of oral care can be seen as a degree of excellence. It attributes to delivering oral care in a specific setting, accessible for each individual, focussed on scientific evidence, clinical expertise and personal needs taking into account financial resources in society. Assessing and improving the quality of oral health care in a systematic way has been laid down in Dutch legislation. Quality improvement in health care has numerous aspects, and one of the important instruments to contribute to improve quality of care is clinical practice guidelines (CPGs) (55-57). CPGs have been defined as 'systematically developed statements to assist practitioner and patient to make decisions about appropriate health care for specific clinical circumstances' (58) and intend to bridge the gap between research findings and current practice.

In the Netherlands, few structured efforts in dentistry have been made to develop, implement and evaluate systematically CPGs (59). CPG development in general health care (55, 60-62) as well as in dentistry (63, 64) has shown to be beneficial in reaching consensus about controversial professional opinions, which are frequently causing unexplained variation between GDPs in patient care. An evidence-based CPG should contain criteria and recommendations for appropriate oral health screening items tailored to individual recall intervals.

Many patients do not receive appropriate health care (65), or receive unnecessary (66, 67) or even harmful oral care (68). Quality of oral care provided should offer the best available care (i.e. analysis of harmful and beneficial effects) at the right time related to individuals most at risk. To improve patient care, a systematic approach is highly advocated (69) by planning specific steps, i.e. get insight into actual practice, analyse potential barriers and facilitators, develop and implement an improvement program and monitor continuously using indicators. In a population with low oral disease prevalence, a paramount opportunity for both primary as well as secondary prevention is becoming reality, providing the rationale of assigning individual risk related intervals.

A substantial body of implementation literature regarding effects of different strategies for quality improvement in medical practice suggest multifaceted implementation strategies (70-75). Experts on implementation in medical care have suggested that interventions should be tailored to the performance aspects that are most in need of improvement (72, 74).
Research on implementation programs to improve decision-making in clinical dentistry is rare. Two studies reported on the impact of CPG on guideline-consistent clinical behavior concerning the management of third molars and concluded that no clinical effect was found between solely CPG-dissemination by mail and CPG dissemination completed with feedback and audit on clinical decisions (76, 77).

This thesis is divided into four sections, addressing the following research questions:

Section I: Dentist and patient reports and views on current practice
- What are the perceptions and professional opinions of GDPs on ROEs?
- What do regular attending patients prefer concerning ROE intervals?

Section II: Assessing professional performance
- In which way do GDPs perform ROEs with regard to the oral health status of regular attendees?
- Which patient-, GDP- and practice characteristics determine clinical ROE behaviour?

Section III: Evidence-based recommendations
- What scientific evidence is available on effectiveness of ROEs and to assess individual risk for oral disease tailored to appropriate recall intervals?

Section IV: Enhancing patient-tailored risk management
- Is it possible to develop and implement a clinical practice guideline (CPG) on ROEs with recommendations concerning appropriate oral health assessment items resulting in evidence-based preventive and operative care tailored to individual recall intervals?
- Can a set of risk-based patient vignettes be developed and used as an educational assessment tool for GDPs?
- What is the effect of a multifaceted implementation strategy concerning patient-tailored risk strategies on GDPs' clinical ROE behaviour?

Outline of the thesis

To find answers on the posed research questions, we present in section I the preferences of dentists and patients concerning current practice. **Chapter 1** presents the results of a questionnaire survey conducted in year 2000 in a representative sample of Dutch GDPs. A random sample of GDPs was questioned on ROE relevance, different content items to perform and on the types of recall policy they are used to apply. In **Chapter 2** we present a repeated survey questionnaire, conducted in year 2005, of which a substantial number of GDPs was also involved in the year 2000 questionnaire.

Patient's values on routine dental visits in The Netherlands are unknown, but are relevant in providing appropriate oral care. **Chapter 3** describes a survey in which patients' preferences for routine dental checks were collected by means of a questionnaire, containing a 19-item Likert-type scale. GDPs as well as patients' opinions reflect the 'state of the art' in routine oral screening in daily practice.

In Section II, we explore more in detail how GDPs perform ROEs in current practice in patients with different oral conditions, and to what extent patients'- practice- and GDPs' characteristics are responsible for differences in clinical performance. A prospective clinical case-recording study in 128 general dental practices is presented. Therefore GDPs were provided with specifically developed recording forms to be filled out immediately after completing one of the 10 randomly selected ROE patients. **Chapter 4** provides an insight in clinical performance on items concerning the domains patient history, examination and risk analysis. A multilevel regression analysis to explain which characteristics determine clinical behaviour is described in **Chapter 5**.

Section III deals with the search for evidence to provide conclusions for clinical practice. Together with the explored clinical expertise, recommendations and instruments for improvement are developed. We searched in electronically databases for evidence on clinical- and cost-effectiveness of ROEs and risk related aspects concerning oral diseases. In **Chapter 6** we present a literature review concerning the effectiveness of ROEs and aspects of ROEs related to risk management for various oral conditions. The evidence base for management and treatment of asymptomatic mandibular wisdom teeth in young adults was explored. This is an important and relevant ROE topic for dentists, with considerably impact on patients. Results are described in a systematic Cochrane review in **Chapter 7**.

Section IV covers the instruments for improvement. In 2004 and 2005, the explored evidence base is used to develop a consensus-based CPG using a RAND-modified Delphi procedure with two expert panels for different age groups of patients (< 18 years and ≥ 18 years). Identification by experts of risk factors involved in ROEs was the rationale of the structured RAND-modified Delphi procedure eventually resulting in a representative set of 19 risk-based patient vignettes. The vignettes covering all relevant risk profiles were used as instrument to facilitate the CPG development process, executed by a multidisciplinary guideline committee. **Chapter 8** describes a study on the development of risk-based patient vignettes as a tool for continuing professional development in general dental practice as well as for undergraduate dental education and a pilot conducted to assess the applicability. To study the effects of a CPG on clinical performance, a multifaceted implementation experiment was conducted in 51 general dental practices. The study design of a cluster randomised clinical trial is presented in **Chapter 9**. Finally, **Chapter 10** pays attention to the results of a cluster-randomised clinical trial, based on implementation research conducted in general dental practice in The Netherlands.

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Section I

Dentist and patient reports and views on current practice

Chapter 1

Routine oral examination: Differences in characteristics of Dutch general dental practitioners related to type of recall interval.

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Abstract

Objectives

The aim of this study was to explore differences in behaviour (characteristics and opinions) among general dental practitioners (GDPs), using either a fixed (Fx) or an individualised recall interval (Iv) between successive routine oral examinations (ROEs).

Methods

In the year 2000 data were collected by means of a written questionnaire sent to a random stratified sample of 610 dentists of whom 521 responded, of which 508 (83%) were used for analysis.

Results

Two groups of GDPs were distinguished based on their answer to the question 'Do you apply for all patients a fixed recall interval between two successive ROEs?'. Fifty-one percent of the GDPs (n=257) applied Fxs for all patients, generally a period of 6 months. Ivs were applied by 49% (n=251) of GDPs, depending on the determination of specific patient characteristics. Logistic regression analysis showed that GDPs applying Fxs also used fixed periods between successive bitewing radiographs for all patients. Furthermore, dentists applying Ivs required more time to conduct a ROE, partly because of a more extensive periodontal screening. GDPs applying Fxs, adhered more to the opinion that a fixed recall regime (every six months, as existed before 1995) should be re-introduced, whereas the GDPs in support of Ivs were more in favour to support the opinion that the ROE is 'an excellent instrument for effective, individualised oral care'.

Conclusion

Dutch GDPs differ in the way they are dealing with the determination of recall interval frequency. These are also specific differences in performance and opinions regarding ROE. With the changing prevalence of oral diseases and the skewed distribution within populations further research is advocated on consistent decision making to determine the most appropriate recall policy in preventing oral disease.

Keywords

Routine oral examination, recall interval, dental practice, professional attitudes, quality of oral care.

Introduction

Routine oral examination (ROE) refers to periodic data collection on the general and oral health status of patients. By comparing the data from a ROE to those obtained from previous examinations or to known references, disease onset or progression can be diagnosed. The purpose of a ROE is to prevent oral diseases, and to detect oral diseases at an early stage in such a way that only minimal interventions are required to arrest their progression. The recall interval, i.e. the period between two successive ROEs, can be either fixed or individualised. A fixed recall interval (Fx) is the same period of time for all patients between successive ROEs, whereas an individualised recall interval (Iv) varies among patients and is based on the assessment of the individual risk for disease onset or progression.

An international debate on the application of Fxs or Ivs for ROEs is ongoing (1-5). There is little scientific evidence available for the determination of appropriate patient-tailored recall intervals (6). Moreover, scientific literature does not provide unambiguous evidence relating regular dental attendance to good oral health (7-11). Recent studies report regular attendees to have fewer teeth (12), and experience significant less pain and discomfort (13, 14). Attendance patterns are also influenced by patients' perceptions of the effect of oral health on quality of life (15).

The combination of several preventive measures such as the collective use of fluoride toothpastes, public oral health campaigns and regular dental visits, raised interest in oral health among the public (16-19) resulting in decreased caries prevalence in Western countries (20). In The Netherlands, from 1948 until 1995 (reform of the national health care system) two routine oral examinations a year were compulsory for all public health care (PHC) insured people as a requirement for reimbursement of costs for dental treatment. In 1981, 60% of the Dutch population regularly visited the dentist for a ROE, and by 1998 this percentage had increased to 80% (21). Moreover, the interval between ROEs did not change much from an average of 6.0 months before 1995 to 6.9 in 2001 (22), whereas the recall interval for ROEs in Finland moved away from fixed to individualised (3, 4).

It is unclear as to why general dental practitioners (GDPs) apply Fxs or Ivs. With a decreased incidence of common oral diseases, i.e. caries and periodontal disease, the effectiveness of Fxs can be disputed, since many patients would get their check-up too early, while others would be too late for an early intervention. However, this very problem is also associated with intervals based on a patient's individual risk profile in case the estimation of the interval is incorrect. The predictive validity of diagnostic needs for caries and periodontal disease may be fair on a population level (23), yet on an individual level they are difficult to apply. After all, the progression of oral diseases not only depends on individual risk factors (24), but also on the availability of manpower in dentistry (25), the characteristics of dentists and dental practices (26) and the variation in diagnostic performance. This variation among dentists is ubiquitous and the extent to which this affects oral care, is unknown (27). Decisions on recall patients in primary care also have potentially an impact on health care resources and outcomes (28). Research in understanding provider behaviour concerning the assignment of recall intervals is emerging (28-30).

To improve consistent and evidence-based decision making with regard to ROEs, research on the

determination of appropriate content and frequency of ROEs is needed. Therefore, the purpose of this study was to explore differences in behaviour (characteristics and opinions) among GDPs, using either Fxs or Ivs between successive ROEs.

Methods

This study was conducted as part of the Data Stations Project of the Dutch Dental Association (NMT). The overall objective of this project is to periodically collect data on delivery of oral care, on practice management, and on GDPs' opinions and views erregarding actual issues in dentistry (31, 32). For this study, conducted in May 2000, a group of 610 GDPs, randomly selected from the population of 5,772 GDPs in The Netherlands (Box 1) was requested to fill out a questionnaire on ROEs. Other questions concerned general and profession-specific personal characteristics.

Box 1. Dental practice in the Netherlands in 2000

Total population: 15,8 million inhabitants

Number of dentists (64 years or younger): 7,284

Number of dentists(GDPs) in private practice: 5,772

Number of dentists otherwise occupied in dentistry: 1,512

Dental practice: 76% of Dutch dentists work in a single-handed practice, and 24% in group practices. The majority of the GDPs run their office as a private enterprise.

Practice routines: On average about 2.500 patients visit the practice at least once a year for a dental check-up, which is free of charge for public health care (PHC) insured patients. The PHC is a health care insurance compulsory for people with a yearly income under € 30.000,-. About 57% of the Dutch population is 'PHC'-insured, whereas 43% has a private insurance. The PHC covers full medical care, whereas the coverage of dental treatment requires additional private insurance. Patients with a dental insurance generally pay 25% of the costs of the dental treatment themselves.

Continuing dental education (CDE) activities:* CDE is on a voluntary basis. Over 50% of the dentists attend CDE actively at least once a year. About 25% of all dentists participate in dental peer groups.

Practice size (1, 2, 3 or more units), mean number of patients and dentists per practice, and mean and modal number of auxiliary staff per practice in the Netherlands

	1 dental unit	2 dental units	3 or more dental units
percentage of dental practices	42%	44%	14%
mean number of dentists	1.1	1.4	1.8
mean number of patients	2,207	2,620	3,180
mean number of dental assistants (modus)	1.6 (2.0)	2.3 (2.0)	3.5 (3.0)
mean number of dental hygienists (modus)	1.2 (0)	0.6 (0)	1.1 (1.0)
mean number of secretaries (modus)	1.1 (0)	0.9 (0)	1.2 (0)

Source: Bruers JJM, Zorgverlening door tandartsen. Nieuwegein: Dutch Dental Association, 2000.

*: CDE-activities: peer review, continuing education.

Procedure

The questionnaire was sent to 610 private practice GDPs in The Netherlands. The initial mailing included an introductory letter, a confidential coded questionnaire, and a reply-paid envelope. GDPs who did not return the questionnaire within four weeks received a written reminder and, if applicable, were reminded for a second time by telephone after 2 months.

Questionnaire

The questionnaire comprised 22 items pertaining to three types of variables (characteristics): personal and practice characteristics (Table 1), ROE characteristics (Table 2) and professional opinions (Table 3). The questionnaire was pretested by experienced dentists and assessed by a panel of research experts from three dental schools.

Finally, participants were asked to indicate the level of agreement with five statements regarding ROEs in oral health care by means of the following ordinal scale: agree; neither agree/nor disagree; disagree. The question 'Do you apply for all patients a fixed recall interval between two successive ROEs?' could be answered with 'yes' or 'no'. Those who were in favour of Ivs (the 'no' answers), were additionally asked to point out which stated specific patient characteristics were relevant for their decision-making, like the number of restorations, the number of new carious lesions, the extent of gingivitis, the number of periodontal pockets, patient preferences, dental mindedness, age and health risks.

Statistical analysis

Relationships for the 51 independent variables within the 22 items of the questionnaire with the dependent variable 'the type of recall interval' were analysed with t-tests and Chi-square tests for 2 x 2 tables. Sixteen bivariate personal and practice- and ROE variables with an Alpha (α) between 0.00 and 0.15 (Table 1 and Table 2) were selected for stepwise logistic regression analyses (forward and backward) with the dependent variable 'the type of recall interval'. Four out of sixteen selected variables were dichotomised, and these were the mean number of days for continuing education, mean number of patients, mean number of PHC-insured patients and the time spent on a ROE. The three selected 'professional opinion' variables (Table 3), within the same Alpha range were also subjected to stepwise regression analysis with the 'type of recall interval' as dependent variable. Therefore the responses to the five questions to the category 'neither agree, nor disagree', which represented small proportions, were counted as 'disagree'. The level of statistical significance was set at α=0.05.

Table 1. General dental practitioners' personal and practice characteristics stratified for fixed (Fx group) and individualised recall intervals (Iv group) between routine oral examinations, standard deviation (SD) and p-value

Characteristics	**Fx group (SD)**	**Iv group (SD)**	**All respondents (SD)**	**p-value**
Practitioner:				
Number of males	230	215	445	
Number of females	27	36	63	0.23
Mean age in years	45.7 (7.6)	46.1 (7.5)	45.9 (7.5)	0.64
Mean number of parts of days per year spent on continuing education activities[A]	20.3 (16.2)	24.3 (19.8)	22.3 (18.2)	0.02
Mean number of chair side hours per week	34.3 (7.6)	33.3 (7.6)	33.8 (7.6)	0.16
Practice:				
Mean number of patients	2,910 (1,515)	2,603 (1,629)	2,758 (1,578)	0.03
Mean number of public health care insured patients	1,746 (227)	1,432 (215)	1,600 (224)	0.00
Mean number of patients with well balanced oral health [B]	2,447 (1,189)	2,177 (1,139)	2,314 (1,125)	0.59
Mean number of patients with discomfort and pain per week[C]	5.0 (4.6)	4.2 (4.8)	4.6 (4.7)	0.21
Mean hours per week working with dental assistants	54.4 (43.7)	51.7 (41.6)	53.3 (42.6)	0.53
Mean hours per week working with oral hygienist	8.3 (15.6)	6.4 (13)	7.4 (14.4)	0.16

[A] participation in structured peer review, continuing education, congress visits.
[B] the number of registered patients attending the dental practice at least once a year.
[C] the number of emergency visits per week per practice within the group of regular attendees.

Table 2. Bivariate relations between routine oral examination characteristics and the use of fixed or individualised recall intervals and p-value

Routine oral examination characteristics (n)	**Items in questionnaire**	**p-value[1]**
Practitioner		
Fixed/individualised recall interval (1)		
Time span in minutes (1)	More or less than 10 minutes	0.00
Number of diagnostic examinations (10)	Diagnosis of caries	
	Assessment of restorations	
	Assessment of oral hygiene	
	Assessment oral mucosa	0.08
	Assessment of orthodontic treatment need	
	Perform a periodontal screening	
	Update status praesens	
	Making radiographs	0.00
	Perform a functional examination	
	Perform pulp vitality tests	
Frequency radiographs (1)	Bitewing radiographs, fixed or individualised intervals	0.00
Indications for peri-apical radiographs (9)	Presence of a fistula	
	Pain experience	0.13
	Trauma	
	Periodontal problems	
	Discoloration of teeth evaluating different treatments	0.08
	Assessment third molars	
	Abnormalities of the oral mucosa	0.09
	Treatment evaluations	
Record keeping data (11)	Diagnosis of caries	
	Results of radiographs	
	Anamnesis/patient history	0.05
	Abnormalities of oral mucosa	0.12
	Trauma, dental wear	
	Oral hygiene (plaque- and bleeding-index)	
	Growth and development	0.12
	CPITN-(DPSI-)score [2]	0.01
	Emerge of a functional problem	0.03
	Bleeding and attachment loss	0.03
	Asymmetry	
Practice		
Delay time (1)[3]	More or less than 2 weeks	
Performers ROE (2)	GDP	
	Dental hygienist/auxiliaries	

1: Items selected for regression analysis ($0.00 > p > 0.15$).
2: DPSI: Dutch Periodontal Screening Index, derived from CPITN-index.
3: The time left between the appointment and actual performance of the ROE.

Results

The questionnaire was returned by 521 out of 610 GDPs . Thirteen respondents were excluded from further analysis for reasons of incidental missing values. This resulted in 508 respondents (83%). The personal and practice characteristics of GDPs in the study population are summarised in Table 1. Eighty-nine percent of the respondents (n=445) were male. The mean age of the respondents was 45.9 years (SD = 7.5) and the mean number of patients per practice was 2,758 (SD = 1,578). A comparison of characteristics of the respondents with all other dentists in the Netherlands aged ≤ 64 year revealed no statistically significant differences regarding gender, age, practice residence and year of graduation. Two groups of GDPs were distinguished based on their answer to the question 'Do you apply for all patients a fixed recall interval between two successive ROEs?' Almost 51% of the GDPs (n=257) applied Fxs, generally a period of 6 months. The other group of GDPs (49%, n=251) applied Ivs, depending on specific patient characteristics.
Analysis of the bivariate relations with 'the type of recall interval' as dependent variable revealed significant differences between the Fx versus Iv group with regard to GDPs personal and practice characteristics (Table 1) and ROE-characteristics (Table 2). Regarding personal and practice variables significant differences were found between groups of GDPs regarding to the mean number of days per year spent on continuing education (p = 0.02), the mean number of patients in dental practice (p = 0.03) and the mean number of PHC-insured patients (p = 0.00). Concerning ROE characteristics, GDPs applying Ivs spent more time on a ROE (p = 0.00), especially for periodontal screening (p = 0.00). Furthermore, they recorded a larger number of clinical observations in a patient record, such as patient history data (p = 0.05), Dutch Periodontal Screening Index (DPSI)/ Community Periodontal Index of Treatment Needs (CPITN)-index (p = 0.01), bleeding on probing and loss of attachment (p = 0.03) as compared to GDPs within the Fx group. GDPs applying Fxs between ROEs, also applied more frequently fixed intervals when making bitewing radiographs as compared to the Iv group (p = 0.00) (Table 2).
Multiple logistic regression analyses with 'the type of recall interval' as dependent variable and the 16 selected variables on personal-, practice- and ROE characteristics revealed significant odds ratios for 'the time spent on the ROE', 'the screening of periodontal diseases' and 'the interval between successive bitewing radiographs' (Table 4). GDPs in the Fx group also adhered more to a fixed interval for all patients when making bitewing radiographs. The group of GDPs, applying Ivs spent more time on a ROE and focussed more on periodontal screening.

The results from a second logistic regression analysis with the 'type of recall interval' as dependent variable and three selected opinions (Table 3) revealed significant odds ratios for the statements 'an excellent instrument for effective, individual oral care' and 're-introduction of a fixed recall regime' (Table 4). GDPs applying Fxs, adhered more to the opinion that a fixed regime (every six months, as existed before 1995) should be re-introduced, whereas the GDPs in support of Ivs were more in favour to support the opinion that the ROE is 'an excellent instrument for effective, individualised oral care'. The results of the logistic regression analyses were the same for both models using forward and backward selection of variables.

Table 3. Professional opinions of general dental practitioners (% of respondents), stratified for fixed (Fx) and individualised recall interval (Iv) between routine oral examinations and the p- value (probability of the opinions in both groups being statistically significantly different)

Opinions	Fx (%) n=257	Iv (%) n=251	p-value
Routine oral examination may cause dental overtreatment:			0.02*
• Disagree	83	73	
• Neither agree, nor disagree	11	16	
• Agree	6	11	
Routine oral examination can be considered as the cornerstone of individual prevention in oral care			0.72
• Disagree	6	7	
• Neither agree, nor disagree	2	3	
• Agree	92	90	
Routine oral examination is an excellent instrument for delivering effective individual oral care			0.06*
• Disagree	9	7	
• Neither agree, nor disagree	7	2	
• Agree	84	91	
Routine oral examination for public insured people, as existed before 1995 twice a year, should be reintroduced			0.00*
• Disagree	35	66	
• Neither agree, nor disagree	30	16	
• Agree	35	18	
Routine oral examination is of importance for dentists to secure a solid economical practice management			0.30
• Disagree	24	27	
• Neither agree, nor disagree	36	40	
• Agree	40	33	

*: Selected for regression analysis (0.00 > p > 0.15).

Table 4. Odds ratios with 95% confidence intervals and p-values from multiple logistic regression analyses with the type of recall interval (Iv=0/ Fx=1) as dependent variable and professional opinions and routine oral examination (ROE) characteristics as independent variable

	Odds ratios (95% CI)	p-value
ROE characteristics		
Time spend on ROE[1]	0.62 (0.41 - 0.93)	0.02
Periodontal diseases screening	0.50 (0.34 - 0.73)	0.00
Fixed interval bite-wing radiographs	2.56 (1.76 - 3.80)	0.00
Professional opinions		
'Excellent instrument for effective individual care'[2]	0.31 (0.14 - 0.66)	0.00
'Compulsory ROE twice a year'[2]	2.72 (1.77 - 4.18)	0.00

[1]: Time spent by the professional, dichotomised to less or more than 10 minutes.
[2]: Three points scale dichotomised to 'agree/disagree' by counting 'did not know' as 'disagree'.

Discussion

This study reports on GDPs' self-reported behaviour towards ROEs. It was concluded from this study, that nearly equal numbers of Dutch GDPs applied Fxs and Ivs respectively between successive ROEs. GDPs assigning Fxs also used fixed periods between successive bitewing radiographs. Dentists assigning Ivs require more time to conduct a ROE, partly because of a more extensive periodontal screening. Differences found in this study may be partly explained by a stronger focus of GDPs who prefer Ivs on data collection aspects other than screening of carious lesions, such as patient history and periodontal screening. Additionally, reflection on Ivs and individual risk assessment is time-consuming, and accurate record keeping and explicit communication with the patient will extend the time required for conducting a ROE. This group of GDPs apparently is more focussed on collecting and evaluating clinical data to underpin individual risk assessment in an attempt to prevent oral diseases. In contrast, both groups adhere strongly (≥ 90%) to the opinion 'the ROE can be considered as the cornerstone of individual prevention in oral care' (Table 3), which could possibly be due to different perceptions on prevention of oral diseases. The gain may well be that explicit and recurrent communication with patients during a ROE, as part of a risk assessment policy, regarding prevention of disease and the role of individual risk factors might enhance patients' knowledge on aspects of oral health. Ivs could, hence, result in the delivery of more preventive and patient-oriented oral care.

It is not surprising that GDPs assigning Fxs on ROEs also applied fixed periods regarding successive bitewing radiographs. For too long, GDPs were focussed on caries detection during a ROE, causing some reluctance in conducting individual risk assessment. They apparently have a preference for systematic decision-making based on their long-term experiences within the compulsory system, which explains that these GDPs adhere stronger to the re-introduction of a compulsory ROE twice a year (Table 4).

The relative high mean age of the GDPs (45.9 years; SD = 7.5) means that most undergraduate training has been completed at least two decades ago. At that time, training in dental school was focussed mainly on knowledge and technical skills rather than information and problem-solving skills. Fxs for regular attendees were found appropriate among dental professionals and public health organisations, leading to a more practice-based rather than an evidence-based culture. According to this survey, GDPs' personal- and practice variables other than age, such as the mean numbers of patients ($p = 0.03$) and the mean number of PHC-insured patients ($p = 0.00$), seem to be more determinative variables to assign Fxs or Ivs (Table 1).

Implementing new practice routines requires much time and effort (33). With the existing manpower problem in Dutch dental care, resulting in an increasing workload (25), it is obvious that GDPs tend to decrease rather than extend the time for a ROE in favour of a blanket recall policy for all patients. This especially counts for the 'fixed' group of GDPs which actually provide care to larger numbers of patients (Table 1). Routinely, they save time during a ROE by assigning Fxs, but fail to gain practice time by extending the recall interval for patients with a minor risk for progress of oral disease. Selecting patients with a low-risk profile may be effective (4), and the assignment of Ivs for these patients can be safely extended beyond the previously accepted standard of 6 months. The recall frequency of low-risk patients may be reduced to once every 12 to 18

months without jeopardizing their oral health status (1, 2, 4).
Opinions and needs of patients regarding ROEs are yet unknown. Although the prevalence of oral disease decreased (16–20), the recall interval in The Netherlands did not change much from 6.0 in 1995 to 6.9 months in 2001 (22). Obviously, also patients still stick to traditionally six monthly recall visits, even if it is not related to their individual risk profile. From a quality of care perspective (efficacy and quality of live) and for reasons of effectiveness, it seems however preferable to prevent the onset of oral diseases by using individual risk profiles. Further research in patient's perceptions regarding the content and frequency of ROEs is strongly advocated.
During a ROE, GDPs have to gather various clinical data mainly regarding early manifestations of two common oral diseases: dental caries and periodontal disease. Accurate record keeping and retrospective analysis of clinical data from previous ROEs are a prerequisite for a reliable assessment of disease onset and progression, and will possibly improve appropriate and efficient delivery of oral care. According to this study significant differences exist with regard to the screening of periodontal disease, the time spent on a ROE and recordkeeping between both groups of GDPs. This could be the result of different oral health strategies. Numbers of preventive or restorative treatments are indications thereof. With regard to preventive oral health performances of dentists conducting a ROE, some studies (34, 35) reported gender differences. In primary care, gender differences were reported on assignment of revisit intervals (30). Female providers assigned shorter revisit intervals than male providers. However, in this study significant differences between GDPs' gender with regard to assignment of the recall interval were not found. Interestingly, a small but significant difference exists between both groups regarding the number of days per year spent on continuing education. GDPs assigning Ivs spent on average more time on continuing education activities. Possibly, risk assessment techniques and tailored recall systems are a topic in postgraduate courses and those who attend these courses apply this into practice in an attempt to improve the quality of diagnostic decision-making.
Results from clinical trials on differences in oral health outcomes, measured in patients from GDPs assigning Fxs and Ivs are not available. A design of trial studies is advocated, in which the assessment of oral health should not only be based on observations of caries and periodontal disease but also on assessment of pain, discomfort, function and patient satisfaction (36). To increase agreement among GDPs on the estimation of recall intervals, specifically designed computer software programmes could be helpful (37). With the increasing tendency to delegate dentist's duties in daily practice to dental assistants, explicit communication on the interpretation and registration of relevant patient data between GDPs and their co-workers are indispensable. Clinical practice guidelines, developed by well-designed consensus- and implementation methods (38, 39), and with the commitment of patients, could play an anticipating role in achieving more agreement between GDPs and as a result in improving the quality of clinical decision-making. With the changing prevalence of oral disease and the skewed distribution within populations one may expect that an Iv policy, based on appropriate risk assessment and supported by contemporary computer technology, could improve the quality of oral care. To underpin these hypotheses further research is needed into the most appropriate and cost-effective recall strategy in preventing oral diseases.

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Chapter 2

Predictors of recall assignment decisions by general dental practitioners performing routine oral examinations.

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Abstract

Objectives

The aim of this study was to explore decision-making behaviour of general dental practitioners (GDPs) in performing routine oral examinations (ROEs). Change in time was studied by comparing data from a cohort sample participants in two surveys in 2000 and 2005, respectively.

Methods

A written questionnaire was sent to 809 dentists (509 responses) and 475 (61%) were used for analysis. 347 respondents also participated in the survey in 2000. The mean number of diagnostic ROE items per ROE was 6.9 (standard deviation = 1.7) . Groups of GDPs were distinguished based on their answer to the question 'Do you apply for all patients a fixed recall interval between two successive ROEs?' and four personal profiles.

Results

Of the GDPs 38,5 % (n=183) assigned fixed recall intervals (Fxs) for all patients. Individual recall intervals (Ivs) were applied by 61,5% (n=292) of GDPs, depending on specific selected patient characteristics and risk factors. Logistic regression showed that GDPs applying Fxs also used fixed periods between successive bitewing radiographs. Furthermore, GDPs applying Ivs conducted more frequent periodontal screening and in case of periodontal problems are more intended to prescribe radiographs. Over a five-year period, a shift towards Ivs assignment from 49% in 2000 to 61,5% in 2005 was found.

Conclusions

Differences in assigned recall intervals (Fxs versus Ivs) by GDPs are determined by three clinical ROE-predictors and two GDP-profiles. A shift towards a more individual assessment was found between 2000 and 2005 in the way Dutch GDPs are dealing with the assignment of recall interval frequency.

Keywords

Dental practice, professional attitudes, quality of oral care, routine oral examination, recall interval assessment.

Introduction

The main purpose of conducting routine oral examinations (ROEs) is to prevent the onset of oral diseases (primary prevention) and/or prevent further progression of prevalent oral diseases, i.e. caries, dental erosion, periodontal disease and oral cancer, by carrying out different diagnostic procedures in combination with oral health preventive advice and feedback (1–4). The time period between two successive ROEs, can be either fixed or individualised. A fixed recall interval (Fx) is the same period of time for all patients between successive ROEs, whereas an individualised recall interval (Iv) varies among patients and is based on the assessment of the individual risk for disease onset or progression (3).

Internationally, the assignment of Fxs or Ivs for ROEs in dentistry is still a topic of ongoing debate (5–12), fuelled by the decline of caries prevalence in most Western countries, a plea for more evidence-based clinical performance and the need for appropriate use of health care resources and outcomes (13). Recently, systematic reviews (1, 4) and a clinical practice guideline (2) advocated a more risk-based recall strategy based on good scientific evidence.

In The Netherlands, about 80% of the population regularly visits their dentist (mostly twice a year) (14), implying that relatively healthy individuals are frequently scheduled for routine oral screening in dental practice. The effectiveness of this system can be disputed, since short intervals may limit unnecessarily the accessibility to oral care, while for others inappropriately extended intervals prevent early interventions and could affect oral health. The progression of oral diseases does not only depend on individual risk factors and -indicators (15). Other relevant factors are the variation in diagnostic performance (16), the availability of manpower in dentistry (17), the differences between dentist's characteristics and differences in dentist's orientations in delivering oral care (18, 19) and the willingness of patients to visit the dentist regularly.

Although recent observational research (20) in the Netherlands revealed that regular attending patients prefer adherence to fixed recall intervals twice a year, a national reform of the public health insurance system in 2004 was conducted resulting in no reimbursement of ROEs, mainly due to reasons of efficacy. It has not been established how general dental practitioners (GDPs) currently make decisions to recall patients in primary oral care. A recent study showed that half of the GDPs (50%) assigned all patients to have a ROE twice a year (3), irrespective of individual risks for oral disease. Research in understanding provider behaviour in general health care concerning risk-based assignment of recall intervals is emerging (21–24). More knowledge about key features (clinical performance and associated factors) and GDPs professional profiles is needed to identify performance gaps and barriers for change. Therefore, the purpose of this study was twofold: (a) to explore actual clinical ROE management (content and frequency) and factors associated on risk assignment of recall intervals among GDPs in 2005; and (b) evaluate differences in behavioural change of GDPs between 2000 and 2005.

Methods

This study was part of the Data Stations Project of the Dutch Dental Association (NMT). The overall objective of this project is to collect data periodically on delivery of oral care, on practice management, and on opinions and views of GDPs regarding actual issues in dentistry (25, 26).

Study population

This study was conducted in April 2005 among a random group of 809 GDPs, who participated in the national Data Stations Project (26) and was proportionally stratified according to gender, age, and geographical spread. A substantial sample of respondents (n=347) also participated in the ROE survey carried out in 2000.

The GDPs were requested to fill out a questionnaire on performance and opinions regarding ROEs, and on personal orientations. Other questions concerned general and profession-specific personal characteristics.

Procedure

The questionnaire was sent to 809 GDPs who were professionally occupied in private practice in The Netherlands. The initial mailing included an introductory letter, a confidential coded questionnaire, and a reply-paid envelope. GDPs who did not return the questionnaire within four weeks received a written reminder and, if applicable, were reminded for a second time, by telephone, after 2 months.

Variables and instruments

The questionnaire comprised 29 items pertaining to three types of variables.

(1) Personal and practice characteristics, such as age, gender, work hours and management hours, dental education activities, reading scientific literature, number of patients (adults vs. children/adolescents), number of dental auxiliaries, and dental hygienists).

(2) ROE characteristics, such as clinical data concerning the number of specific diagnostic items, frequency of bitewing radiographs (BW) prescription, indications for specific radiographs, record-keeping data and time span of conducting ROEs.

(3) GDP orientation in four professional profiles (19): orientation towards patients; professionalism; task delegation; and business.

To examine differences in clinical performance regarding risk-oriented assignment the questions 'Do you apply for all patients fixed recall intervals between two successive ROEs?' and 'Do you prescribe for all patients fixed BW-frequencies as a part of successive ROEs?' could be answered with 'yes' or 'no'.

Those who were in favour of individual recall assignment and individual prescription of BWs (i.e. those who gave the 'no' answers), were additionally asked to point out which patient characteristics were decisive for their risk-based decision making, such as specific risk factors and risk indicators, patient preferences, dental awareness, age, health risks and other aspects not mentioned in the questionnaire. Those who adhered to fixed assignment, both for recall interval and BW prescription, could fill out which fixed recall interval (month) they preferred for all their patients (selected range 3-36 months) and which frequencies they preferred for prescription of BWs (6-60 months).

To determine professional profiles, participants were asked to score on a numerical scale (0-100%), to what extent they identified themselves with four described professional profiles.

The questionnaire was pretested by experienced dentists and assessed by a panel of research experts from three dental schools.

Table 1. Subgroups of general dental practitioners (numbers and percentages) categorised by individual assignment type of recall interval and frequency of bitewing radiographs, and the preferred items for individual assignment

Preferred items*	**Recall interval n=292 (61,5%)**		**Bitewing frequency n= 265 (56%)**	
Specific risk factors/indicators	237	84%	219	84%
Patient preferences	219	75%	71	27%
Dental awareness and motivation	195	69%	147	56%
Age	140	48%	159	61%
Risk for general health	76	28%	62	24%
Other patient factors	24	9%	24	9%
Total population (n)	**475**		**474**	

*More answers per respondent were possible

Table 2. Subgroups of general dental practitioners (numbers and percentages) categorised by fixed assignment type of recall interval and frequency of bitewing radiographs, and the preferred frequencies for fixed intervals and BW prescription

Preferred frequency*	**Recall interval n=183 (38,5%)**		**Bitewing frequency n= 209 (44%)**	
≤ 6 months	158	33,2%		
8 - 9 months	11	2,3%		
12 months	7	1,5%	10	2%
24 months	7	1,5%	52	11%
36 months			128	28%
48 months			14	3%
Other period	7	1,5%	5	1%
Total population (n)	**475**		**474**	

*More answers per respondent possible.

Statistical analysis

Frequencies of the mean number of diagnostic items per ROE with standard deviations (SD) were calculated for all respondents and both subgroups. For the Ivs group, frequencies of preferred items and combinations of specific risk factors and/or patient factors were analysed and for the Fxs group the preferred frequencies were analysed (Table 1 and 2). Relationships for the 39 independent variables within the 29 items of the questionnaire with the dependent variable 'the type of recall interval' were analysed with t-tests and Chi-square tests for 2 x 2 tables. Sixteen bivariate personal, practice and ROE variables with an alpha (α) between 0.00 and 0.15 (Table 3

and 4) were selected for logistic regression analyses (forward and backward) with the dependent variables 'the type of recall interval' as well as 'the prescription frequency of BWs'. The three selected 'orientation profiles' variables (Table 5), with the same α value, were also subjected to stepwise regression analysis with the 'type of recall interval' as dependent variable. Fifteen out of a total of 19 selected variables were dichotomised. Subgroup analyses (comparison of groups), with the same dependent variables were conducted to evaluate differences in time focussed on the group respondents (n=347), who participated in both questionnaires on ROEs carried out in 2000 and 2005. The level of statistical significance was set at α=0.05.

Table 3. Personal and practice characteristics of general dental practitioners stratified for fixed (Fxs) and individualised recall intervals (Ivs) between ROEs

Characteristics	**Fx group mean (SD)**	**Iv group mean (SD)**	**All respondents mean (SD)**	**p-value**
Personal:				
Practitioners (n):	183	292	475	
Male (n)	150	241	391	
Female (n)	33	51	81	
Mean age in years (SD)	47.6 (7.8)	48.8 (7.5)	48.2 (7.7)	0.12 [D]
Mean h/mth CDE [A] (SD)	4.1 (3.1)	3.9 (3.1)	3.9 (3.1)	
Mean chair side time h/wk (SD)	31.9 (6.7)	31.2 (7.2)	31.5 (7.1)	
Mean management time h/wk (SD)	6.9 (4.4)	6.9 (4.3)	6.8 (4.3)	
Mean time h/mth reading literature (SD)	6.4 (4.1)	6,2 (5.5)	6.4 (4.7)	
Practice:				
Mean number of patients (SD) [B]	2,943 (1,898)	2,609 (1,448)	2,732 (1,633)	0.04 [D]
Percentage public health care insured patients (SD)	56.4 (13.7)	56.9 (13.5)	56.6 (13.6)	
Percentage of patients 0–17 yr (SD)	21.6 (10.8)	21.5 (12.1)	21.5 (11.7)	
Mean number of patients/ wk visiting practice (SD)	145 (91.5)	138 (98.2)	141 (95.6)	
Mean number of patients/wk with discomfort and pain (SD)[C]	3.4 (4.6)	3.7 (5.4)	3.6 (5.1)	0.12 [D]
Mean hrs/wk working with dental auxiliaries (SD)	66.5 (66.5)	63.4 (42.4)	64.4 (52.4)	
Mean hrs/ wk working with oral hygienist (SD)	23.8 (18.3)	21.8 (17.6)	22.8 (17.8)	
Mean hrs/wk working with receptionists (SD)	25.7 (19.4)	23.2 (16.8)	24.1 (17.8)	

[A] CDE: continuing dental education: i.e. participation in structured peer review, continuing education, congress visits).
[B] The number of registered patients attending the dental practice at least once a year.
[C] The number of emergency visits per week per practice within the group of regular attendees.
[D] p-values selected for regression analysis ($0.00 > p > 0.15$).
(SD): Standard deviation.

Results

The questionnaire was returned by 529 of the 809 GDPs (65%). Thirty respondents were excluded from further analysis because they were not professionally occupied any more in general dental practice. Twenty-four respondents were excluded for reasons of incidental missing values. This resulted in 475 respondents (61%) of whom 347 also took part in the survey in 2000. Table 3 summarises personal and practice characteristics of all participating GDPs. Eighty-two percent of the respondents (n=391) were male. The mean age of the respondents was 48.2 yr (SD = 7.7 yr), the mean number of patients per practice was 2,732 (SD = 1,633). Comparison of characteristics of the respondents with all other dentists in the Netherlands aged ≤ 64 yr revealed no statistically significant differences regarding gender, age, practice residence and year of graduation. In comparison with the 2000 questionnaire the proportion of females increased from 12 to 17% and also the mean age from 45.9 to 48.2 yr, while the mean number of patients per practice remained stable (2,732 versus 2,758).

Analysis of three subgroups of participants over a 5 yr period, focussed on the groups ' A: participant 2000+2005' (n=347), ' B: only participant 2000' (n=173) and 'C: only participant 2005' (n=138), revealed that group 'B' did not significantly differ from group 'A' with regard to the assignment of the type (Fx/Iv) of recall intervals.

Therefore, emerged differences in time were not caused by group selection, eliminating the option of loss of a high proportion of either Fx- or Iv- oriented participants. Analysis of group 'A' participating in both questionnaires (n=347), showed that the percentage of GDPs assigning Ivs in 2000 (49%), increased to 65% in 2005. Comparison between group 'A' and 'C' showed that the latter adhered significantly more to Fxs (48%) (p = 0.06). Analysis of the background characteristics of group 'C' identified significantly more females (p<. 0001), younger in age (p<. 0001), and less involved as the manager/owner (p<. 0001). Based on the type of recall assignment, either fixed or individual, 38.5 % of the GDPs (n=183) assigned for all patients Fxs (mostly 6 months), while 61,5% (n=292) assigned Ivs, depending on specific risk factors and/or patient factors (Table 1 and 2).

For the prescription of BWs (either fixed or individual), 44% of the GDPs used fixed prescription for all patients, in most cases once every 36 months, while 56% prescribed BWs based on specific patient characteristics (specific risk factors in combination with specific patient factors). Within the Ivs-group (n=292), decision items mentioned for the length of the recall period were specific risk factors /indicators (84%), 'patient preferences' (75%), 'dental awareness and motivation' (69%), 'patient's age' (48%), 'risk for general health' (28%), and 'other patient factors' (9%). In assigning Ivs, 20% of GDPs (n=55) did not use specific risk factors (like caries, periodontal disease and plaque accumulation), but they referred only to combinations of other patient factors like 'dental awareness and motivation' combined with 'patient preferences' (60%), and 'dental awareness and motivation' combined with 'age' (46%). Eighty per cent of GDPs (n=237) used specific risk factors in combination with other patients factors for establishing an individual recall assignment policy, 55% always preferred to combine patient factors 'dental awareness and motivation' and 'patient preferences', and 38% of the GDPs preferred to combine patient factors 'age' and 'patient preferences' with specific risk factors.

Table 4. Bivariate relations in 2005 between routine oral examinations (ROE) characteristics, practitioner characteristics and practice characteristics, and the assignment of fixed (Fxs) and individualised (Ivs) recall intervals between ROEs with p-value

ROEs (n)	**Items in questionnaire**	**p-value**[1]
Practitioner		
Fixed/individualised recall interval (1)		
Time span (minutes) (1)	More or less than 10 minutes	
Number of diagnostic examinations	Diagnosis of caries	
	Assessment restorations	
	Assessment oral hygiene	
	Assessment oral mucosa	0.01
	Assessment orthodontic treatment need	
	Perform a periodontal screening	0.01
	Update dental record form	
	Making radiographs	
	Perform a functional examination	
	Perform pulp vitality tests	0.04
	Analysis dietary habits	
	Feed back diagnosis patient	
Frequency radiographs	Fixed or individualised bite wing radiographs periods	< 0.0001
Indications for peri-apical radiographs	Presence of a fistula	
	Pain experience	
	Trauma	
	Periodontal problems	0.02
	Discoloration of teeth	0.04
	Assessment third molars	0.03
	Abnormalities of the oral mucosa	
	Treatment evaluations	0.03
Record keeping data	Diagnosis of caries	
	Results of radiographs	
	Anamnesis/patient history	
	Abnormalities of oral mucosa	
	Trauma, dental wear	
	Oral hygiene (plaque- and bleeding index)	
	Growth and development	0.11
	CPITN- (DPSI-) score [2]	0.12
	Emergence of a functional problem	0.04
	Bleeding and attachment loss	0.00
	Asymmetry	
	Analysis dietary habits	
	Feed back individual risk profile	
Practice		
Delay time [3]	More or less than 2 wk	
Time between ROE and consecutive treatment [4]	More or less than 4 wk	0.12

[1]: p-values selected for regression analysis (0.00 > p > 0.15).

[2]: DPSI, Dutch Periodontal Screening Index.

[3]: The time left between the appointment and actual performance of the ROE.

[4]: The time between the ROE and the successive treatment.

Table 5. Professional profiles of general dental practitioners (GDPs) (% of respondents) in 2005, stratified according to fixed (Fxs) and individualised (Ivs) recall intervals with p-value

GDPs Profiles	Fxs	Ivs	p-value*
Patient orientation[1]	71.0 (21.6)	76.1 (19.3)	0.01
Professional orientation[2]	50.8 (26.3)	46.1 (24.8)	0.05
Business orientation[3]	59.2 (28.9)	55.3 (26.8)	0.12
Orientation on task delegation[4]	32.4 (28.3)	30.7 (27.2)	0.53

*: p-values selected for regression analysis (0.00 > p > 0.15).
1: Oral care focussed on patient communication, coaching and feed back regarding diagnosis and treatment options.
2: A priori focussed on technical aspects of profession and new technological developments of oral care, in cooperation with, and respected by, like-minded dentists.
3: Management, professional organisation and financial benefits are keynotes with a service friendly performance for patients.
4: Practice organisation is strongly based on delegation of tasks between professionals with special specialities and patient treatment of other practices.

Regarding the content of ROEs (type and number of diagnostic items performed), the mean number of specific diagnostic examinations carried out by all GDPs (as listed in Table 4) was 6.9 (SD = 1.7) of which 'diagnosis of caries', 'assessment of restorations' and 'oral hygiene' were assessed by all GDPs consistently. Furthermore, 'assessment of oral mucosa' was carried out by 92% of the GDPs, 'patient feedback diagnosis by 73%, and 67% performed 'periodontal screening'. Updating the patient's history (record keeping) was carried out by 50% of the respondents. Between both groups (Fxs vs. Ivs) no significant differences were found in the mean number of diagnostic examinations performed [Fxs: 6.7 (SD = 1.6) vs Ivs: 7.0 (SD = 1.7); p= 0.12].
Multiple logistic regression analyses with 'the type of recall interval' as dependent variable and the 19 selected significant bivariate variables on personal and practice characteristics, ROE characteristics and GDPs orientations showed that Ivs-assigning GDPs also more frequently perform periodontal screening (odds ratio, 0.47; 95% confidence interval (CI): 0.29-0.75) than their colleagues who assign fixed intervals. They are also more inclined to prescribe radiographs in the event of emerging periodontal problems (odds ratio, 0.92; 95% CI: 0.84-0.99). GDPs who favoured Fxs for all patients were also more inclined to prescribe fixed periods for BWs (odds ratio, 2.18 ; 95% CI: 1.39-3.39) (Table 6).
Looking at preferred profiles, significant odds ratios emerged for two profiles (i.e. patient orientation and professional orientation) (Table 6). A greater number of patient-oriented GDPs were more likely to assign Ivs (odds ratio, 0.49; 95% CI: 0.27-0.87), while GDPs linked to the technical and professional challenges of dentistry were more inclined to assign Fxs (odds ratio, 2.06; 95% CI: 1.29-3.26). The results of the logistic regression analyses were identical for both models using forward and backward selection of variables.
To recognise possible differences between BW types (Fx/Iv), another logistic regression analysis was conducted with 'the prescription frequency of BWs' as dependent variable and the same selected independent variables on personal and practice characteristics, and ROE characteristics

and personal orientations. Analysis resulted in one significant odds ratio for the practice variable 'mean number of patients' (odds ratio, 1.97; 95% CI: 1.27-3.06). This implies that GDPs occupied in practices with more regular attendees rely more on systematic decision making by fixed prescription of BWs (in most cases every 36 months).

Table 6. Odds ratios, confidence intervals (CI) and p-values from multiple logistic regression analyses in 2005 with the type of recall interval (Iv=0/ Fx=1) as dependent variable and general dental practitioner (GDP) opinions/orientations and routine oral examinations (ROE) characteristics as independent variables

	Odds ratios (95% CI)	**p-value**
ROE characteristics		
Perform periodontal screening	0.47 (0.291-0.751)	0.00
Fixed interval bite-wing radiographs	2.18 (1.398-3.398)	0.00
Radiographs in the event of periodontal problems	0.92 (0.844-0.993)	0.03
GDP profiles		
Patient orientation (focus on communication, advice and feed back)	0.49 (0.273-0.875)	0.01
Professional orientation (focus on technical aspects and developments)	2.06 (1.299-3.260)	0.00

Discussion

GDPs who assign Fxs (generally 6 months) for all patients also adhere more to prescription of fixed frequencies for BWs. They are not inclined to perform periodontal screening systematically, and recognised themselves more as dentists a priori focussed on technical aspects of their profession and new technological developments. Over the last 5 years they represented, within the dental profession in The Netherlands, a decreasing number of GDPs, while their counterparts, in assigning Ivs, represent GDPs more focussed on patient-specific care (i.e. risk assessment), resulting in individual assigned recall intervals and individual frequencies of BW prescription. The overall results from these cross-sectional surveys of self-reported GDPs' recall assignment decisions indicate that the most significant clinical variables (periodontal screening and Fx/ Iv-prescription of BW radiographs) from the 2000 questionnaire seem to be consistent clinical predictors for recall assignment behaviour of GDPs in the Netherlands.

The response rate (65%) of this study was lower than the 2000 survey (85%) which might introduce bias. However, recurrent assessment towards the representativeness of the overall sample within the Data Station Project gives rise to the conclusion that the results can be considered as representative for the population of all GDPs (25). Furthermore, an overall shift was observed towards the assignment of Ivs over the last five years (49% to 61,5%), and even within the group of GDPs who participated in both questionnaires (n=347), from 50 to 65 %.

However, looking at the way that a remarkable proportion (20%) of the Ivs GDPs (n=292) deal

with individually risk-based assignment, some critical notes can be made. After all, excluding clinical risk factors/indicators (such as caries, periodontal disease, plaque accumulation) from the assessment procedure to assign recall intervals is hard to explain.
It suggests that non-clinical factors influence individual recall periods in daily practice. One of the reasons why GDPs adhere to Ivs may be the recent national reform of the public health insurance system (2004), which resulted in the exclusion of ROEs for reimbursement. Patients may also be more focussed on effective health care interventions as a result of emerging opinions in society, fuelled by the longstanding national government policy to control the expanding costs of health care and proclaiming more individual responsibility for maintaining individual oral health. This policy could influence the public opinion by encouraging patients to re-assess their dental recall compliance (historically twice a year). Although age was not a significant predictor for the type of recall assignment, the mean age of 48.2 yr (SD = 7.7) of participants could influence individual recall assignment. The population of this study represents an experienced group of GDPs (professionally occupied for at least 20 year or longer in dental practice) who probably become familiar with risk-based assessment of individual patients. In the subgroup 'participants 2005' (n=138) recently graduated dentists (more females, younger in age) showed more adherence to Fxs (48%), which might be explained by a lack of clinical experience and performance uncertainty with regard to the estimation of disease progression.
The paradigm of evidence-based practice, emerging over the last decades in combination with a more pronounced attention for quality of life, has led towards more cost-effective and personal risk-based interventions, especially in dentistry where many regular attendees represent a relatively healthy population of individuals.
Professional arguments, based on the decreased prevalence of oral disease, could influence the recall assignment. Recently, an extensive clinical practice guideline on recall assignment has emerged in the United Kingdom (2) as well as two systematic reviews (1, 4), promoting a more individualised strategy in selecting patients for recall intervals.
Both reviews conclude that there is no evidence to support Fxs for all patients. Another compelling result of the present study is, that no substantial shifts occurred in the prescription of fixed or individualised BW-frequencies by GDPs between 2000 (Fxs, 43%; Ivs, 57%) and 2005 (Fxs, 44%; Ivs, 56%).
Both in 2000 and 2005, a strong correlation was found to exist between Fxs and fixed BW frequencies ($p < .00001$) for all patients. As the percentage within Fxs group decreased over a 5-yr period from 51% to 38,5%, one could also expect – as a consequence of an integrated risk-assessment policy – a more individualised prescription of BWs. After all, the considerable decrease in caries experience, in combination with the tendency for a lower rate of progression of carious lesions in young individuals in industrialised countries (27, 28), should result in a decreasing frequency of BWs for these individuals who are at lower caries risk. This will protect low-risk individuals from unnecessary radiation (13). Limited research data are available with regard to lesion progression in adults, both for caries (29) and for periodontal disease (30). GDPs probably adhere to 'safe' mean fixed frequencies for BWs because of the complex individual

assessment of lesion activity and lesion progression both for caries and periodontal disease in children and adults. Financial incentives and standardised usual care might also influence clinical decision-making. An overall individual risk assessment strategy, including also the individual prescription of radiograph frequency should be promoted. The latter topic was not incorporated in the recent emerged NICE guideline (2).

Based on the extensive variation in clinical performance (16), we expected significant differences in personal and practice characteristics of GDPs assigning Fxs or Ivs (Table 3). However, this did not occur. The GDP profiles (orientations) explored in this study revealed some additional data, which indicate a more patient-tailored performance within the Ivs group, while in the Fxs group technical orientation towards oral care prevails (Table 6).

One should realise that the limitations of this type of research (as a result of self-reported behavioural aspects) reveal only general information on assignment predictors at a practice/dentist level rather than at a patient level. From a quality of care perspective in every day practice, different individual risk profiles should lead to differences in clinical performance regarding the content and frequency of ROEs and also in different frequencies of BWs. Formal training programmes (continuing education) using clinical practice guidelines, regarding the assignment of individual recall intervals and BW frequencies, should be promoted to enhance clinical decision-making. According to the variables assessed in this study, special attention should be paid to consistent identification of risk factors/indicators, both for caries and periodontal disease, in continuing personal development courses. These should not only focussed on (early) clinical signs and symptoms, but also on medical and social risk factors/indicators. Recurrent patient history taking, communication, and record keeping are essential for evaluation of oral disease and (short-term) prognosis, resulting in the assignment of recall intervals on an individual basis.

Further research on ROE assessment of GDPs clinical performance, specifically in patients with different risk profiles, should identify performance gaps and potential barriers for change (31) in the decision-making process with regard to effective recall intervals in combination with appropriate radiograph frequencies.

The results of this study give rise to the following conclusions:

(1) A shift towards a more risk-oriented performance for recall assignment, from 49% in 2000 to 61,5% in 2005.

(4) In contrast, the frequency of BW prescription in both groups showed almost no change in fixed periods (43% vs. 44%) or individual periods (57% vs. 56%).

(5) Two clinical predictors, 'assessment of periodontal disease' and 'prescription BWs' were consistently decisive for GDPs' performance, as characterised by their recall assignment preference.

(6) In 2005, both groups of GDPs (Fxs and Ivs) significantly differ in their orientation towards professional performance (i.e. more patient-oriented in the Ivs group, but more technology oriented in the Fxs group).

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Chapter 3

Dental check-up frequency: preferences of Dutch patients.

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Abstract

Objective

In 1995, the requirement to visit the dentist for a check-up every six months was replaced by the obligation to get a routine examination no more than once a year in The Netherlands. The aim of this study was to determine patients' opinions about this change in policy, and to assess their preferences regarding frequency and content of regular dental check-up visits. Possible associations between patients' preferences for regular dental check-ups and a number of antecedent variables, such as dental attitudes, were examined as well.

Design

Patients' preferences for regular dental check-ups were assessed by means of a questionnaire, containing a 19-item Likert-type scale, twelve visual analogue scales and seven forced choice items. Items assessing various background variables and a selection of items of the Dental Attitude Questionnaire (DAQ) were added. This questionnaire was administered to patients of seven dental practices. A total of 428 patients filled out the questionnaire.

Results

Results indicated that patients prefer to have regular dental check-ups. Patients' evaluation of six-monthly dental check-up visits was significantly more positive than their evaluation of flexible, individualised, recall frequencies. Factors positively associated with a higher preference for regular dental check-up visits were female gender, being more satisfied with one's teeth, less cynicism toward dental health care professionals and more intrinsic motivation to maintain one's oral health.

Conclusions

Patients seem to prefer to attend their dentist regularly, at fixed intervals of about six months. This fact should be taken into account when deciding about the most appropriate recall interval between successive dental examinations.

Keywords

Dental check-up visits, recall frequency, social dentistry.

Introduction

Due to major modifications in health care policy in 1995, coverage of dental care services for Dutch people insured by the sick fund diminished substantially. In The Netherlands, about two third of the population is insured for health care costs by the sick fund (1). The sick fund is a government-based health care insurance for people with an annual income lower than €33,000, and covers the greater part of health care services. The remainder (mostly people with higher incomes) is insured by private insurance companies. With regard to routine dental check-ups, the obligatory six-monthly dental check-up for patients insured by the sick fund was replaced by a requirement to visit the dentist for routine dental examination no more than once a year. The rationale for this change in policy was twofold: to improve oral health and to save resources. Considering the purpose of dental check-ups, which is to prevent oral disease or detect signs of it at an early stage and thereby prevent future disease with minimal intervention (2) and taking into consideration the ongoing decrease in the levels of oral disease in The Netherlands, it was no longer deemed necessary to maintain six-monthly dental examination visits.

As early as 1977, the debate was initiated over the scientific basis for six-monthly dental examinations for healthy individuals (3). Many western European countries are now supporting a policy of keeping more flexible periods between dental check-ups, based on an assessment of individual risk factors (4-9). Research carried out in The Netherlands provides some evidence that dentists are indeed individualising recall intervals for patients. For instance, half of Dutch dentists determine check-up frequency based on individual risk factors (10), such as the stability of oral health and the motivation of the patient. Although advocates of individualisation of recall frequencies claim that the empirical evidence indicates there is no increased risk for the development of caries and periodontal disease when extending the recall intervals for low-risk patients (5, 6, 9, 11, 12), a recent systematic review (13) shows otherwise. Results of their review, which investigated the effects of different frequencies of dental check-ups on caries, periodontal and oral cancer outcomes, failed to demonstrate any consistency in the direction of outcome effects. Thus, there is no evidence so far to either refute or support the practice of six-monthly dental check-ups. In summary, the studies mentioned above did not prove very helpful in resolving the controversy over optimal recall intervals. Besides, it is unfortunate that the argument for extended, individualised recall intervals is primarily based on factors related to the progression of oral disease. It is not appropriate though to use only clinical parameters in deciding about recall frequencies, because regular dental examinations serve more functions than just the monitoring of the progression of oral disease. For example, regular contact between dentist and patient enables the establishment of a relationship of trust, making it possible to continuously reinforce preventive advice, to motivate patients and so on (2). Together with the clinical parameters, these additional factors should be incorporated in the decision-making process concerning the issue of dental check-up frequency. Furthermore, in terms of quality of care, which can be defined as the degree to which this care satisfies established or obvious needs (14), it is evident that preferences of patients about dental check-up frequencies should be taken into account as well.

In conclusion, to inform policy on optimal recall intervals, it is of vital importance to gain more knowledge about patients' preferences with regard to frequencies of dental check-ups. Therefore, the aim of the present study was to compare patients' opinions about six-monthly dental check-ups with their opinions about flexible, individualised intervals between dental check-ups. To the best of our knowledge, no prior studies exist on this topic. Hence, this study was exploratory in nature. Furthermore, possible associations between patients' opinions about dental check-up frequency and a number of antecedent variables were also examined. The variables chosen were based on previous research on factors associated with regular dental attendance (15-19). Specifically, we examined whether a number of socio-demographic variables, such as age, gender and education, dental attitudes and subjective oral health were related to patients' opinions about dental check-up frequency.

Methods

Measurement of patients' preferences for regular dental check-ups

Patients' preferences for regular dental check-ups were assessed by means of a questionnaire, containing a 19-item Likert-type scale, twelve visual analogue scales and seven forced choice items. Because of the exploratory nature of this study, we chose to use different methods for reasons of convergent validity; that is, each method has its limitations and converging results will strengthen conclusions.

The 19-item scale consists of nine items concerning the preference of patients for regular dental check-ups (e.g. 'It is important to me that my dentist examines my teeth every six months'), four items concerning patients' perception of the ability of routine dental examinations to reduce the risk of oral disease (e.g. 'By regularly attending my dentist for routine oral examination, I will prevent unnecessary problems with my teeth'), and six items concerning patients' expectations about the nature of a dental check-up visit (e.g. 'My dentist does not spend enough time checking my teeth during the dental check-up visit'). These items had to be answered on a 5-point Likert-scale, ranging from 'totally disagree' to 'totally agree'. Higher scores indicate a higher preference for regular dental check-ups. Total scale score was derived by adding up item scores and dividing this score by the total number of items. Thus, total score ranges from 1 to 5. The twelve visual analogue scales were constructed to assess patients' evaluation of the obligatory six-monthly dental check-up, which was the routine before 1995 in The Netherlands, and their evaluation of the new, more flexible policy, which obliged sick fund patients to visit their dentist no more than once a year for routine examination. Patients were asked to evaluate these two alternatives, six-monthly dental check-ups vs. flexible dental check-up frequency, by marking each of the visual analogue scales on a point between 0 and 100 mm (see Figure 1). Each of the two alternatives had to be evaluated by the following six descriptors: easy–difficult; good for my teeth-bad for my teeth; useful-useless; pleasant-unpleasant; financially attractive-financially unattractive; takes little of my time-takes lots of my time. The twelve visual analogue scales were recoded in 10-point scales, by giving a score of 1 if patients marked the scale between 0 and 10 mm, a score of 2 when they marked the scale between 11 and 20 mm, and so on. Higher scores indicate more positive evaluations of each of the alternatives.

Figure 1. An example of one of the visual analogue scales in the study

In my opinion the obligatory six monthly checkup is:

useful _____ useless

Table 1. Frequencies on the seven forced choice items

Item if I were to choose, than:	N	female	male patients (%)
1 a. My dentist should decide how often I need a dental check-up	294	72	75
b. I will decide myself how often I need a dental check-up	108	28	25
2 a. It matters a lot for my oral health if I get a dental check-up regularly *	348	88	80
b. It does not matter a lot for my oral health if I get a dental check-up regularly	61	12	20
3 a. I would like to combine the routine examination with treatment	295	71	75
b. I would not like to combine the routine examination with treatment	114	29	25
4 a. I would definitely get a dental check-up every six months *	325	83	72
b. I would definitely get a dental check-up less than every six months	85	17	28
5 a. I visit my dentist regularly for a dental check-up	365	91	85
b. I do not visit my dentist regularly for a dental check-up	47	9	15
6 a. I do not wait with making an appointment for a dental check-up until something is really the matter with my teeth	374	92	90
b. I wait with making an appointment for a dental check-up until something is really the matter with my teeth	36	8	10
7 a. I would spend money on getting my teeth checked	337	85	83
b. I would not spend money on getting my teeth checked	66	15	17

* significant difference between male and female patients ($p < 0.05$).

Patients' preferences for regular dental check-ups were also assessed by means of seven forced choice items, corresponding with several aspects of regular dental check-ups, such as the frequency, financial aspects, and so on (see Table 1 for item content). Each of the items consists of two opposing statements, and patients had to choose the statement corresponding most with their opinion.

Measurement of determinants of patients' preferences for regular dental check-ups

Several possible determinants of patients' preferences for regular dental check-ups were assessed: patients' dental attitudes, their subjective oral health and a number of socio-demographics. Patients' dental attitudes were measured by means of a shortened version of the Dutch Dental Attitudes Questionnaire (DAQ) (20–21). The DAQ has six content scales (Cynicism, Health Concern, Motivation, Oral Function, Social Aesthetic, Susceptibility) and two validity scales

(Halo, Infrequency), each containing eight items. For the purpose of this study, four items of each of the following three scales were selected:

(1) Cynicism: the extent to which patients show suspicion regarding the motives of dental health care professionals and downplay the need for regular dental check-ups and oral hygiene (e.g. 'If I was told that I needed 'extensive' dental treatment, I would get a second opinion').

(7) Motivation: the extent to which patients are intrinsically motivated to maintain or improve their oral state or, on the other hand, are motivated primarily through the effort of others (e.g. 'I try to maintain good dental health because it is important to me').

(8) Susceptibility: the extent to which patients believe that they are susceptible to health problems and the degree in which they believe a possible illness impacts on their ability to function well (e.g. 'I believe that I could have a serious dental problem and not be aware of it').

Each of the twelve items had to be answered on a 6-point scale, ranging from 'totally disagree' to 'totally agree'. Total scores for each subscale were obtained by adding up the item scores and dividing this score by the total number of items. Thus, total score for each subscale ranges from 1 to 6, with higher scores indicating respectively less cynicism, higher motivation and higher susceptibility.

Finally, a number of items were added to assess the following patient characteristics: actual frequency of dental check-up visits, change in frequency after 1995, preferred period of time between successive dental check-ups, type of insurance, age, gender, education, income, and perceived dental health. In addition to patients' perceived oral health, both the dentist and the dental assistant were asked to evaluate the patients' oral health by means of a report mark ranging from 1 ('extremely poor') to 10 ('excellent').

Survey procedure

Before distributing the questionnaire to the dental practices, some pilot work was done to see if the wording of the questions was clear and to see how much time it would take to fill out the questionnaire. This resulted in some minor revisions in the formulating of a few questions. After piloting, the questionnaire was administered to patients of seven dental practices, located in seven different communities (both cities and villages) in different parts of The Netherlands over a period of two months (June-July 2003). These solo or group practices, were a convenience sample, obtained from the network of the Academic Centre of Dentistry Amsterdam. None of the seven practices, when asked to participate in this study, refused. Dentists of these practices were informed about the time needed to fill out the questionnaire; all dentists indicated that they would organise their schedule as to make it possible for patients to fill out the questionnaire. Each practice received 125 questionnaires with the request to hand these out to all patients aged 16 years and older, visiting the dental practice during that period. Patients were instructed by the receptionist or, if not available, by the dental assistant, to fill out the questionnaire before their visit to the dentist in the waiting room. They were told that

the questionnaire concerned opinions regarding dental check-up frequency. After the dental visit, both the dentist and the dental assistant gave a report mark from 1 to 10 to the patients' oral health, independent of each other. The practice received 50 eurocents for every filled out questionnaire.

Data analysis

Data were first processed by descriptive analyses (frequencies, means, reliabilities). Patients' evaluations of six-monthly dental check-ups vs. flexible dental check-up frequency were compared by means of paired t-tests. To test for possible differences between dental practices on patient characteristics (age, gender and educational level), several analyses of variance with dental practice as factor (with Bonferroni correction) as well as a chi-square test were performed. Results of this analysis showed that for all patient characteristics, significant differences were found ($p < 0.05$). Closer inspection of the results revealed that one of the seven practices was accountable for all significant differences. In this practice, patients were significantly more often male, higher educated and older. However, because of the relatively big sample size and strict testing, small differences will easily reach significance. The actual size of the differences was negligible (for instance, with regard to education a difference of one scale-point on a 5-point scale), and therefore, it was decided to analyse data of all seven practices together. Differences in scores were tested using t-tests and chi-square tests, and multiple regression analysis was carried out (enter method) to predict patients' preferences for regular dental check-ups from the antecedent variables.

Results

Sample characteristics

Four hundred and twenty eight (48.9%) questionnaires were returned after the two-month period, 37% by male patients and 63% by female patients. According to the dental assistants/ receptionists, almost no patients refused to fill out the questionnaire when asked, but due to time constraints patients did not always have enough time to fill out the questionnaire before the dental visit. Mean age of the patients was 42.9 years (SD = 13.4). 32% of the patients had completed higher vocational education or university, 39% of them had completed intermediate vocational education, higher general secondary education or pre-university education, and 28% had completed elementary school, lower vocational education or lower general secondary education.

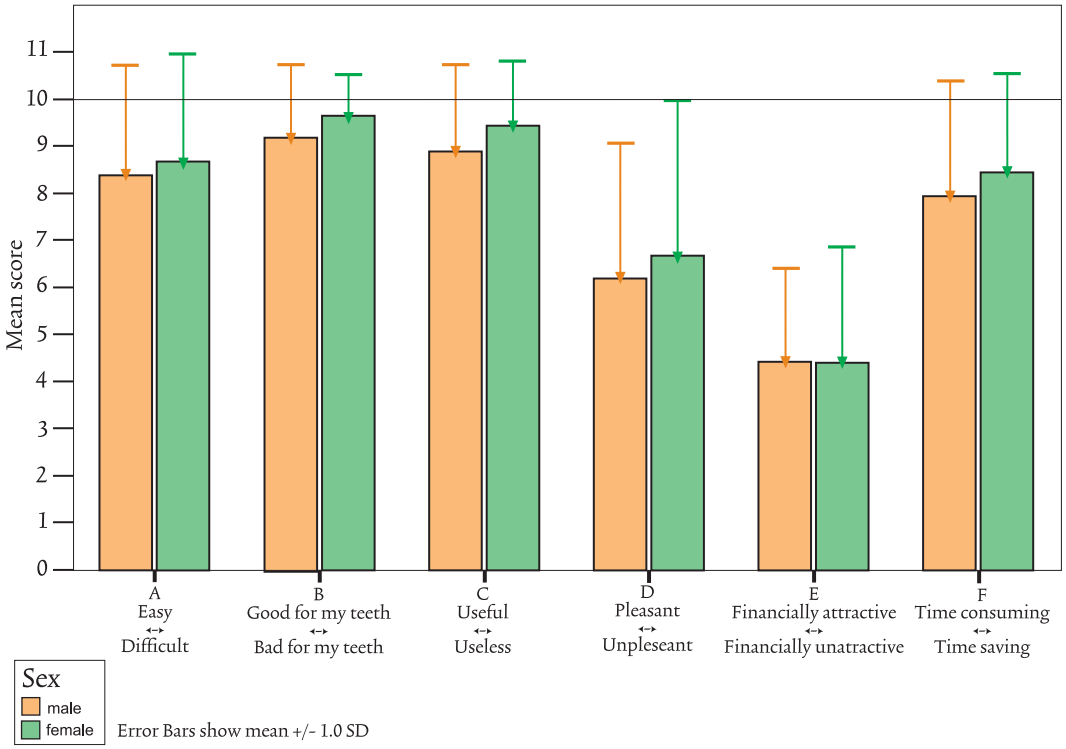
A majority of the patients (73%) reported that their dental check-up frequency had not changed as a consequence of the change in policy in 1995 (20% of the patients stated that they visited their dentist less after the policy change), and a majority of the patients (64%) reported visiting their dentist twice a year for a check-up visit (27% of the patients reported visiting their dentist once a year). Furthermore, almost all patients (92%) said that they had visited their dentist in the last 12 months, and all patients were insured for health care costs (67% were insured by the sick fund and 33% were insured by private insurance companies).

The majority of patients (63%) were of the opinion that their oral health is good or very good, and the same number reported to be satisfied with their teeth. Only 5% of the patients indicated that their oral health is poor, and 8% of patients were dissatisfied with their teeth. The mean report mark dentists gave to their patients' oral health was 6.7 (SD = 1.4), which was almost the same as the mean report mark of the dental assistant (6.8; SD = 1.2). Judgement about patients' oral health of the dentist and dental assistant was highly correlated (Pearson's r= 0.83).

Patients' preferences for regular dental check-ups

The reliability of the 19-item scale assessing patients' need for regular dental check-ups was satisfactory (Cronbach's alpha: 0.78), after deletion of five items that correlated negatively with the total scale. Hence, the total scale used in further analyses consisted of 14 items, seven items concerning the preference of patients for regular dental check-ups, three items concerning patients' perception of the ability of routine dental examinations to reduce the risk of oral disease and four items concerning patients' expectations about the nature of a dental check-up visit. Mean item score of the total scale was 3.83 (SD = 0.43; range 1-5), indicating that patients' preference for regular dental check-ups was relatively high.

Figure 2. Mean scores on the six visual analogue scales for six-monthly visits

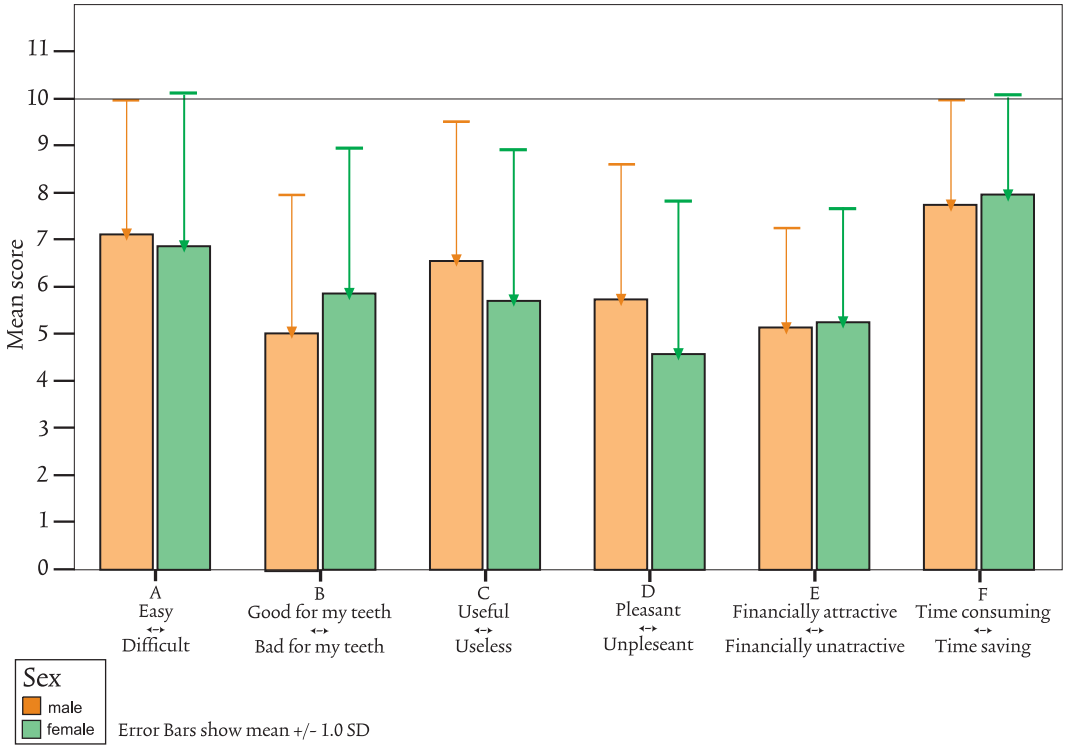


Cronbach's alpha for the six visual analogue scales assessing patients' evaluation of the obligatory six-monthly dental check-up visit was 0.71, and for the six visual analogue scales assessing patients' evaluation of the flexible dental check-up frequency 0.74. Figure 2 gives the mean scores of male and female patients separately on each of the six visual analogue scales with regard to their evaluations of the six-monthly dental check-up visit. Figure 3 gives the mean scores of male and female patients separately on each of the six visual analogue scales with regard to their evaluations of the flexible dental check-up frequency.

As can be seen from both figures, patients' evaluation of the obligatory six-monthly dental check-up visit was significantly more positive ($p < .001$; paired t-tests) than their evaluation of the more flexible alternative, except for their evaluation with regard to the financial attractiveness of both alternatives. Patients evaluated the obligatory six-monthly dental check-up visit as significantly less financially attractive than the more flexible alternative ($p < .001$).

Figure 2 and figure 3 also show that female and male patients score differently on most scales. A series of t-tests revealed that female patients evaluated six-monthly dental check ups as better for their teeth, as more useful and as less time-consuming than male patients. In contrast, female patients evaluated the new, flexible alternative as less useful and less pleasant, but still better for their teeth than male patients ($p < 0.05$).

Figure 3. Mean scores on the six visual analogue scales for flexible visit frequency



The answers on the seven forced choice items confirmed the results found on the 19-item Likert-scale and the twelve visual analogue scales (see Table 1 for item frequencies, given separately for male and female patients). For example, most patients indicated that they prefer to visit their dentist regularly for a dental check-up, that they are willing to spend money to get their teeth checked, and that they feel it matters a lot for their oral health if they visit their dentist for check-up visits regularly. Chi-square tests revealed two significant differences in scores between female and male patients. Significantly more female patients than male patients were of the opinion that it matters a lot for their oral health if they get a dental check-up regularly, and significantly more female patients than male patients reported to definitely get a dental check-up every six months.

Finally, patients indicated that the mean preferred period of time between successive dental check-ups for them is 6.9 months (SD = 2.2).

Determinants of patients' preferences for regular dental check-ups

Mean scores on the subscales cynicism, motivation and susceptibility of the DAQ were respectively 1.9 (SD = 0.71), 5.2 (SD = 0.76) and 4.0 (SD = 0.87), indicating that (a) patients are not cynical toward the motives of oral health care professionals and do not downplay the need for regular dental check-ups and oral hygiene, (b) patients are intrinsically motivated to maintain or improve their oral state, and (c) patients are realistic in their assessment of their susceptibility to health problems; the majority of patients believed that they are able to detect serious oral health problems themselves, and a lot of patients also believed that they will need dental treatment in the coming year.

Univariate analyses showed that patients' preferences for regular dental check-ups, as assessed with the 14-item Likert-scale, was related to two patient characteristics, namely patients' gender and patients' satisfaction with their teeth. Male patients had significantly lower preferences for regular dental check-ups than female patients ($p<.001$), and patients who were less satisfied with their teeth had lower preferences for regular dental check-ups than patients who were satisfied with their teeth ($p=.001$). No other associations were found between patients' preferences for regular dental check-ups and patients' characteristics.

To determine whether patients' preferences for regular dental check-ups could be predicted from the various background variables assessed in this study, a multiple regression analysis was carried out. The following variables were entered in the regression equation: mean scores on cynicism, motivation, susceptibility, patients' age, gender, educational level, income, satisfaction with their teeth, their perceived oral health, and the evaluation on patients' oral health by the dentist/dental assistant. The results of the regression analysis are shown in Table 2. As can be seen, patients' scores on the cynicism and motivation subscales of the DAQ, explained 13.3% of the variance in patients' score on their preference for regular dental check-up scale. The less cynical and the more motivated the patient, the stronger their preference for regular dental check-up visits. The other variables did not contribute significantly to the regression model.

Table 2. Results of regression analysis with patients' need for regular dental check-up visits as dependent variable

Variable:	**R2**	**B**	**P**
Cynicism	.112	-.19	.000
Motivation	.021	.11	.02
Total:	**.133**		

Discussion

Since 1995, Dutch dental patients insured by the sickfund no longer have to attend their dentist every six months for a dental check-up visit. Instead, the new, more flexible, policy which came into effect from that year on obliged these patients to visit their dentist no more than once a year for a routine oral examination. This study addressed the question what patients think about this change in policy, and whether they prefer one alternative over the other.

Unfortunately, only 48.9% of the questionnaires were returned, limiting the weight that can be placed on the results of this study. It should be noted, though, that survey nonresponse is steadily increasing during the last decades worldwide, with The Netherlands being a country with one of the lowest mean response rates at the moment (below 60%) (22). Thus, a response rate of 48.9% is, unfortunately, not much below average in The Netherlands. With regard to this particular study, an explanation for the low response rate is that part of the questionnaires were not actually distributed to all patients. Fortunately, the dental assistants/receptionists indicated that almost no patients refused to participate in the study when asked. However, even when distributed, there may not have been enough time available for patients to fill out the questionnaire before their dental visit.

Taking into account the above, results of our study suggest that patients have a strong preference for regular dental check-up visits. When asked to indicate which period of time they prefer between successive dental check-ups, they reported a mean period of slightly less than seven months. Furthermore, all three different methods used in this study to assess patients' preferences for regular dental check-up visits, the Likert items, visual analogue scales and forced choice items, point in the same direction: when the choice lies in the hand of the patient, they prefer to attend their dentist for routine oral examinations twice a year.

In fact, the majority of patients reported to actually visit their dentist twice a year. These data correspond with recent research, which also indicate no difference in dental check-up visit frequencies before and after 1995 (23). Thus, patients' attendance behaviour with regard to dental check-up visits does not seem to have altered after the change in policy in 1995, despite the fact that about half of the Dutch dentists indicate that they have individualised check-up frequencies (10).

An additional question this study addressed was whether patients' preference for regular dental check-up visits could be explained by a number of background variables, associated with regular dental attendance. Not surprisingly, we found that the less cynical and more motivated the patient, the stronger their preference for regular dental check-ups. Furthermore, female patients

as well as patients who are more satisfied with their teeth, have higher preferences for regular dental check-up visits than male patients and patients who are less satisfied with their teeth. These factors are partly in concordance with factors related to actual regular dental attendance. For example, male patients, patients who are less satisfied with their oral health and patients who are less motivated, are less likely to attend their dentist on a regular basis than females, patients who are satisfied with their oral health and more motivated patients (17-18). Thus, preferences for regular dental check-up visits and actual regular dental attendance seem to be related to each other to some extent. It should be noted though, that the percentage of explained variance was relatively small in this study (about 13%), indicating that other factors, not assessed here, are probably associated with patients' preferences for regular dental check-up visits. Advocates of extending recall intervals, based on individual risk factors, tend to base their arguments on epidemiological data about progression of oral disease. Besides the fact that the evidence for their arguments is not that clear-cut (13), this approach suffers from two additional serious limitations. First, the fact that there is substantial variation in clinical judgements among dentists is neglected (14, 24). Thus, the limited reliability of assessing individual risk factors, may make the approach of individualised recall intervals less than feasible; in other words, it is perhaps better to be safe than sorry. Secondly, the perspective of the patient on the issue of recall frequencies is not taken into account at all. This is not only unfortunate, to say the least, it is also inappropriate when one considers that quality of dental care is as much determined by clinical factors as it is determined by more 'subjective' factors, such as the dentist-patient relationship (25). In order to deliver good quality of care, the relationship between dentist and patient should be one of trust, and this can only be achieved by respecting and incorporating patients' views in the dental decision-making process. Therefore, the decision about the most appropriate interval between dental examinations should be taken by dentist and patient together.

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Section II

Assessing professional performance

Chapter 4

Routine oral examination: clinical performance and management by general dental practitioners in primary care

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Abstract

Objective

The aim of this clinical study was to explore the contents of routine oral examinations (ROE) by Dutch general dental practitioners (GDPs), in relation to the oral health status of regularly attending patients.

Methods

An observational study was performed, based on clinical case-recording. Using The Data Station Project of the Dutch Dental Association as the study base, 215 GDPs were recruited, of which 131 participated. A clinical case-recording form was developed to document clinical behaviour. The contents assessed concerned patient characteristics, contents of ROE visit, diagnoses made, and clinical behaviour in response to ROE findings.

Results

This study showed substantial variation in clinical behaviour related to specific ROE domains, including patient history and record keeping, whereas GDPs acted consistently on other domains, such as clinical examination and recall length assessment.
Furthermore, ROE performance was more strongly associated with GDP characteristics than with patient characteristics. Mean ROE time spent was 10 min and recall intervals were most frequently assigned at 6 months, irrespective of the oral condition.

Conclusion

This study highlights a need for continuing education to promote risk-based oral screening. Further research is needed to identify factors responsible for the variation in GDP performance, just as research on clinical practice guideline implementation methods is warranted.

Keywords

Process assessment, professional practice, quality of oral care, routine oral examination.

Introduction

The purpose of the routine oral examination (ROE) is to prevent oral disease and to detect and treat it at an early stage, in order to be able to manage its course. In 1981, 60% of the Dutch population regularly visited the dentist for a ROE (mostly twice a year), and by 1998 this percentage had increased to 80% (1). However, the effectiveness and efficiency of standardised recall intervals for all patients is subject of ongoing debate (2–5). This paper focuses on current practice routines regarding the contents of the routine oral examination in general dental practice.

The decreased prevalence of oral diseases (particularly caries and periodontal disease) over the past decades has focussed more attention on the early detection and control of oral disease, in such a way that diagnosis and non-operative ('preventive') interventions are instituted at the appropriate time, thereby reducing the need for operative intervention (6). A more individualised risk-based recall strategy can therefore be promoted (7, 8). However, little is known about how general dental practitioners (GDPs) conduct ROEs. The identification of patients with elevated risk for oral disease is mainly based on clinical expertise and intuition (9, 10). The lack of scientific evidence regarding optimal recall intervals prevents change in individual assignment. Furthermore, there is little evidence of the number and type of examinations, necessary for including in a ROE for patients with different risks for oral disease.

A recent questionnaire survey (11) on the contents of ROEs and recall intervals was based on self-reported behaviour. However, questionnaire-based information on clinical behaviour might not fully represent real-life practice. Clinical performance assessment requires data from everyday clinical practice. Such data may be obtained by means of structured immediate recording performed by general practitioners in primary care (12). This so-called clinical case-recording might yield more relevant details on real clinical behaviour and represents a valid and reliable source for performance review.

A better insight into the contents of the ROEs, as used in general dental practice for different types of patients, is likely to provide recommendations that could be used to improve the quality of the dental care provided by professionals to their patients.

The aim of this clinical study was to describe the contents of the ROEs carried out by GDPs, and to relate this to the oral health status of patients in order to determine factors responsible for the variation in the contents and frequency of ROEs in daily practice.

Material and methods

Study population

A total of 529 GDPs from The Data Station Project (DSP) of The Dutch Dental Association (13) were invited to participate in the present study. A total of 215 (41%) expressed their willingness to participate, of which 131 (25%) actually completed the recording procedures detailed below. Information on personal and practice characteristics of the participating dentists was obtained from the DSP study base.

Procedure

The GDPs included were asked to select, on a random working day, eight to ten consecutive patients scheduled for a ROE, and to fill out a clinical case-recording form immediately after completing each of these ROEs, which had to be performed exclusively by GDPs. The patients receiving the ROE were required to be regular (at least once a year) attendees for the last five years. Moreover, only one member of a family could be included as a ROE patient. Data were collected during June and July 2005. Information on the objectives of the study, and 12 recording forms and extensive instruction manuals for appropriate use, were sent to each GDP by post. Participating GDPs were advised to pilot test on two forms before starting the actual recordings. The applicability of the clinical case-recording form was tested in a pilot study by 10 experienced GDPs, and the time used to fill each recording form was recorded. The average time per form was 5-6 min, resulting in an overall estimated time investment of 40–60 min per participating GDP on a randomly chosen working day. All in all, the total time investment per GDP for participation in this study was estimated to be less than 60 min.

Measures and instruments

We used a validated recording method for data collection (12). A clinical case-recording form was developed, which integrated a large number of specific domains and items that are potentially part of the ROE. The rationale for these specific domains was based on the results of a rigorous national RAND-modified Delphi consensus procedure in 2005 concerning the content and frequency of ROEs.

For each ROE patient, the GDP was required to record information in four areas.

(1) Patient characteristics included: age (coded as 0–17; 18–35; 36–59; or 59+ yr); gender; oral disease history (no oral disease ever; now healthy but oral disease history; current dental caries, current periodontal disease, current dental caries and periodontal disease); number of dental visits in the last 5 years; and oral health compliance, (good, moderate or poor) (Table 1).

(2) The following details show the content of the ROE visit. The clinical performance included the domains 'patient risk assessment' (2 items), 'patient history' (5 items), 'clinical examination' (6 items), 'additional examination' (1 item) and 'minor interventions' (2 items) (Table 2).

(3) The following options were available for the diagnoses made during ROE: 'disease-free', 'gingivitis only', 'dental caries only', 'periodontal disease only' or 'dental caries and periodontal disease' (Table 3).

(4) The clinical activities in response to the ROE findings included the domains 'patient communication' (4 items), 'record keeping' (7 items), 'recall assessment (months)' (3 items), and 'time investment (min)' (2 items) (Table 3). In assessing the recall interval, GDPs were asked to estimate for each patient the probability of the onset of oral disease (caries and periodontal disease) within the next year, and finally to record the maintained or altered interval.

Table 1. Characteristics of the routine oral examination (ROE) patient population (n=1,059)

Patient characteristics	**n**	(%)
Gender		
Male	505	(48%)
Female	544	(52%)
Age		
0–17 yr	114	(11%)
18–35 yr	246	(23%)
36–59 yr	547	(52%)
59+ yr	141	(14%)
Oral disease history		
No oral disease ever	91	(8.6%)
Now healthy, but oral disease history	423	(39.9%)
Current Dental caries	314	(29.7%)
Current Periodontal disease	139	(13.1%)
Current Dental caries & Periodontal disease	92	(8.7%)
Number of dental visits in 5 yr		
< 5	52	(5.6 %)
5	107	(11.5%)
6–7	200	(21.4%)
8–9	300	(32.1%)
10	249	(26.7%)
>10	26	(2.8%)
Oral health compliance evaluation		
Good	622	(59%)
Moderate	398	(38%)
Poor	34	(3%)

Table 2. The percentage of routine oral examination (ROE) patients (n=1,059) for whom specific ROE items were carried out [Also given are mean overall domain scores (%) with confidence intervals (CI) and intraclass correlation coefficients (ICC)]

Clinical performance	**%**	**(95% CI)**	**ICC**
Patient risk assessment	*39.5*	*(33.4-45.2)*	*0.65*
Assessment medical risk*	33.8		
Assessment periodontal risk**	45.3		
Patient history	*55.9*	*(52.4-59.3)*	*0.51*
Oral health compliance	99.9		
Pain/discomfort	90.7		
Medical aspects	40.0		
Social aspects	21.0		
Oral health aspects	71.7		
Clinical examination	*95.9*	*(95.9-97.7)*	*0.25*
Caries	99.1		
Gingivitis	98.6		
Periodontal disease	97.2		
Assessment of restorations	92.6		
Oral mucosa	93.7		
Growth and development	87.6		
Additional examination: Bitewing radiographs	*19.4*	*(16.2-21.8)*	*0.06*
Minor interventions	*31.8*	*(29.3-34.3)*	*0.20*
Polish/ Removal of calculus	59.1		
Application of fluoride	5.4		

*: Medical risk score based on recommendations of the American Association of Anaesthesiologists.
**: Dutch Periodontal Score Index based on recommendations of Dutch Association of Periodontology.

Statistical analysis

Because of the two-stage sampling procedure (ROE patients clustered within GDPs), the confidence intervals (CIs) were corrected for design effect, and we calculated the intracluster correlation coefficients (ICCs) related to clustering of patients within GDPs (14). The ICC is a measure of the relatedness of clustered patient data and based on the ratio of the variance within clusters of ROE patients and the variance between clusters of ROE patients (i.e. between GDPs) (15).

Results

Population

A total of 1,070 ROEs were reported by the 131 GDPs who participated. Three GDPs were excluded for further analysis for reasons of missing data. This resulted in 1,059 ROE observations conducted by 128 GDPs. The mean number of recordings per GDP was 8.27 [standard deviation (SD) = 0.73].

Most (84%) of the participating GDPs were men. The mean age of the GDPs was 48.6 yr (SD = 7.3); the mean number of patients per practice was 2,716 (SD = 1,866). No statistically significant differences in personal and practice variables were observed between those 131 GDPs who participated in this clinical case recording study and those 398 who did not. Fifty-two per cent of the ROE recordings concerned female patients (n=544), and most ROE recordings concerned patients aged between 18 and 59 yr. The ROE patients' oral health compliance (attitude towards appropriate oral health self-care and maintenance) was assessed as good in 622 (59%) patients, moderate in 398 (38%) and poor in 34 (3%) patients (Table 1).

Oral health assessment

A review of 'patient risk assessment' (medical and periodontal risk scores) was performed in 39.5% (95% CI: 33.4-45.2) of the patients. The patient history (current problems/discomfort, medical, social and dental items) was updated in 56% of the ROE patients (95% CI: 52.4-59.3) (Table 2). Clinical examinations concerning caries, gingivitis, periodontal disease, restorations and oral mucosa were performed in 93.7-99.1% of the patients, whereas growth and development was assessed less frequently. 'Additional clinical examinations', in the form of bitewing radiographs were carried out in 19.4% (95% CI: 16.2-21.8) of the patients, whereas specific interventions, including removal of small calculus deposits and polishing of stained teeth were performed in nearly 60% of the ROE patients.

Patient communication

'Patient communication', (i.e. feedback and advice) was performed in 24.5% (95% CI: 22.5-26.6) of the ROE patients recorded and concerned issues such as subsequent treatment, fluoride intake, dietary advice, and oral hygiene (Table 3). Concerning plaque accumulation and oral hygiene deficiencies, GDPs provided more personal advice and feedback to patients with pathological oral conditions, compared with disease-free patients. In the event of dental caries-only, feedback and advice on the items 'fluoride intake' and 'dietary advice' was given in 5.5% and 17.6 %, respectively, of the recorded cases. Mean overall significant differences occurred GDP communication with patients between disease-free patients and patients experiencing only gingivitis, dental caries, periodontal disease, and the combination of dental caries and periodontal disease (Table 3).

Table 3. Mean percentage of routine oral examination (ROE) patients in whom general dental practitioners (GDPs) carried out specific ROE activities, given according to the observed oral health status of the patients [also given are the 95% confidence intervals (CI) and intraclass correlation coefficient (ICC) for the overall mean percentages within the ROE domains 'communication', 'record keeping', 'recall assignment' and 'time investment']

	ROE performance according to patient oral health status (n=1,038)				
	Disease-free (n=371)	**Gingivitis only (n=221)**	**Dental Caries only (n=199)**	**Periodontal disease only (n=158)**	**Caries + Periodontal disease (n=89)**
Patient communication					
Overall score: 24.5% (95% CI: 22.5-26.6) ICC: 0.20	14.3% (12.1–16.4)	25.2% (22.4–28.1)	35.2% (31.6–39.2)	30.4% (26.9–33.8)	32.9% (28.6–37.1)
Subsequent treatment	18.1%	26.7%	65.8%	41.1%	64.4%
Fluoride intake	4.9%	2.3%	5.5%	4.4%	1.1%
Dietary advice	5.7%	6.3%	17.6%	5.7%	6.7%
Oral hygiene/self-care	28.6%	65.6%	51.8%	70.3%	59.6%
Record keeping					
Overall score: 21.4% (95% CI 18.9-23.8) ICC: 0.38	10.5% (8.5-12.6)	25.3% (21.9-28.6)	26.9% (23.7-30.1)	28.2% (23.9-32.5)	33.1% (27.4-38.7)
Findings on radiographs	12.4%	21.7%	32.7%	17.1%	27.0%
Initial caries lesion	4.6%	8.6%	61.8%	6.3%	20.9%
Amount/location plaque	11.3%	47.1%	28.8%	34.8%	32.6%
Amount/location BOP*	11.3%	48.0%	24.1%	47.5%	39.3%
Periodontal pockets	5.4%	11.3%	3.5%	43.7%	34.8%
Patient preferences	15.9%	20.4%	19.6%	29.1%	25.8%
Level of oral health compliance	2.9%	19.9%	18.1%	19.0%	18.0%
Recall assignment (mean in months, 95% CI)					
Overall score: 7.00 (95% CI: 6.8-7.2) ICC: 0.29	7.3 (7.0-7.6)	7.2 (6,8-7.5)	6.8 (6.5-7.1)	6.4 (6.1-6.7)	6.5 (6.1-6.9)
Recall < 6 months	5.0%	1.4%	1.5%	8.3%	4.7%
Recall 6 months	70.3%	68.6%	77.0%	78.3%	80.0%
Recall > 6 months	29.1%	30.0%	21.4%	13.4%	15.3%
Time investment (mean in min, 95% CI)					
Overall score: 10.3 (95% CI: 9.5-11.0) ICC: 0.49	9.0 (8.3-9.7)	11.2 (10.1-12.2)	10.1 (9.4-10.8)	11.8 (10.4-13.2)	10.6 (9.2-12.0)
Clinical oral examination only	4.5 (4.1-4.8)	4.8 (4.3-5.3)	4.6 (4.2-4.9)	4.8 (4.4-5.3)	4.8 (4.3-5.3)
Other aspects**	4.0 (3.4-4.5)	5.2 (4.6-5.8)	5.0 (4.5-5.5)	5.8 (5.0-6.6)	5.1 (4.2-6.0)

*: BOP: bleeding on probing.

**: 'Others aspects' comprised items as 'assessment of radiographs', 'patient record keeping', 'communication/feedback' and 'referral letters'.

Record keeping

Overall, an average of 21.4% (95% CI: 18.9-23.8) of the record-keeping items were used for the ROE patients (Table 3). Significant differences in record-keeping items by GDPs were found between disease-free patients and patients affected by oral disease. The amount and location of plaque and bleeding on probing (BOP) were recorded in 11.3% of the disease-free patients. The amount and location of plaque and BOP were about 3-4 times higher for patients with 'gingivitis-only' (47.1% and 48%, for plaque and BOP respectively), with 'periodontal disease-only' (34.8% and 47.5%), and in patients with the combination of caries and periodontal disease (32.6% and 39.3%). Patient levels of oral health compliance in the four disease categories were registered in nearly one out of five patients, but in only 2.9% of those who were free of oral disease. Recordings of patient preferences (related to intervention suggested) were performed in 15.9% of the disease-free patients and in 34.8% of the patients with caries and periodontal disease (Table 3).

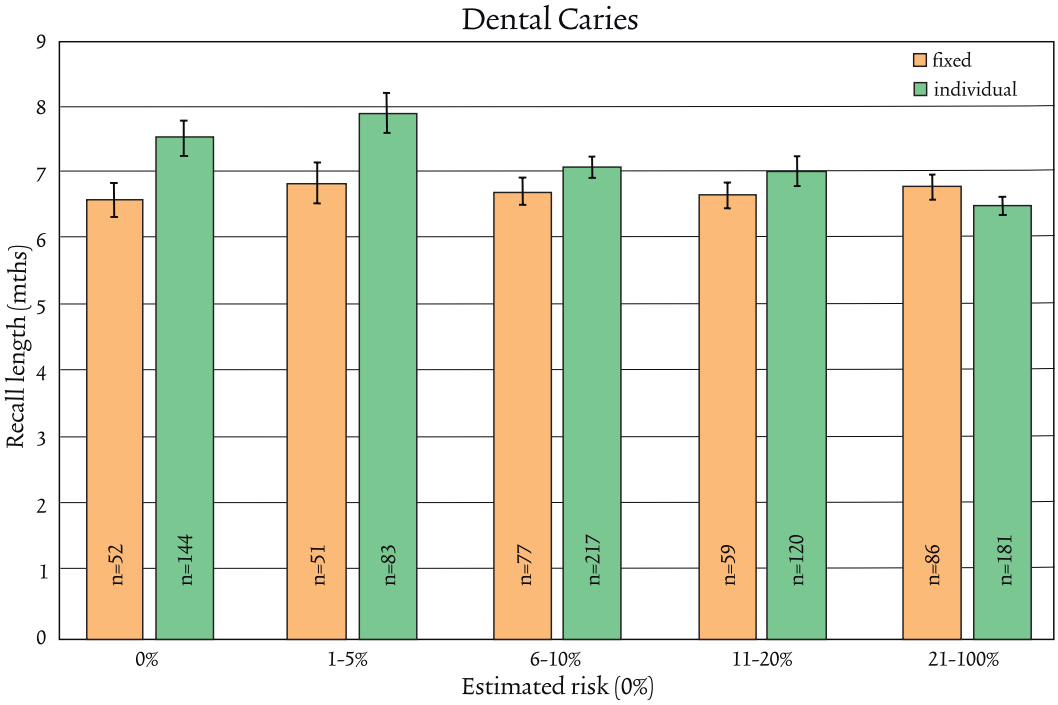
Assessing the recall interval

The mean overall recall interval prescribed was 7.0 months (95% CI: 6.8-7.2). The mean recall intervals for five selected oral conditions showed small, but significant differences between disease-free patients, (7.3 months; 95% CI: 7.0-7.6), and patients affected by periodontal disease, (6.4 months; 95% CI: 6.1-6.7) or patients affected by caries and periodontal disease, (6.5 months; 95% CI: 6.1-6.9) (Table 3). For the total patient population, the most frequently assigned recall interval was 6 months, whereas periods extending beyond 6 months (mostly 12 months) were assigned for a smaller percentage of the ROE patients (Table 3). The recordings within the low-risk categories (n=592, 'disease-free' and 'gingivitis-only') showed that 70.3% of the 'disease-free' group and 68.6% of the 'gingivitis-only' group visited the dental practice every six months for routine oral screening. The observational context of the study prohibited determining exactly which consecutive risk-management steps were performed by GDPs. However, the recall interval was not related to estimated caries-risk scores (%), and this was the case both for GDPs who assign fixed recalls (n=40) for all patients and for GDPs (n=88) who assigned variable recall intervals (Figure 1).

Time investment

The overall mean time spent per ROE was 10.3 min (95% CI: 9.5-11,0) and varied from 9.0 min (95% CI: 8.3-9.7) in 'disease-free' patients to 11.8 min (95% CI: 10.4-13.2) in patients with a 'periodontal condition-only'. For the five selected conditions, the time spent on 'clinical examination-only' varied from 4.5 min (95% CI: 4.1-4.8) in disease-free patients to 4.8 min (95% CI: 4.4-5.3) in patients with 'gingivitis-only', 'periodontal disease-only' and 'caries and periodontal disease', and showed small and non-significant differences. Overall, differences in time spent were related to the non-clinical items like 'assessment of radiographs', 'communication', 'record keeping' and 'referral letters', which were grouped under 'Other aspects' (Table 3). Significant time differences existed for non-clinical items between 'disease-free' patients (4.0 min; 95% CI: 3.4-4.1), 'gingivitis-only' (5.2 min; 95% CI: 4.6-5.8), and 'periodontal disease-only' (5.8 min; 95% CI; 5.0-6.6), respectively.

Fig. 1. Mean time (in months) to the next recall visit for a routine oral examination (ROE) in patients with different levels of estimated risk for dental caries in the next 12 months. Bars are presented for general dental practitioners (GDP) who assign fixed recall intervals (n=40) and GDPs who assign variable intervals (n=88). Errors bars denote the 95% confidence interval (CI)



Discussion

The results of this study showed substantial variations in clinical behaviour between GDPs for specific ROE domains, in particular 'patient history', 'patient communication' and 'record keeping'. However, GDPs acted very consistently on ROE-domains like 'clinical examination', 'recall interval assessment' and 'time investment'. Performance and clinical decisions made were more strongly associated with GDP characteristics than with patient characteristics. A strong tendency existed to assign 6-monthly recall intervals, irrespective of the oral condition of patient. Between the five oral diseases categories, significant differences were observed in recall assignment and in ROE time spent, but the differences were small and have uncertain clinical relevance. The differences in total ROE time spent, according to the five oral conditions, appear to be caused by ROE aspects other than clinical examination, such as assessment of radiographs, record keeping and patient communication items.

Dutch dentists, like most dentists in western European countries, mainly apply standardised ROE procedures for caries and periodontal disease, rather than focus on risk-based assessment of oral disease. Possible explanations for this clinical behaviour may relate to time management and efficient practice organisation, patient preferences, peers-accepted practice routines, financial

incentives related to the reimbursement system, and a tendency to be always on the safe side.
In 2005, a rigorously developed evidence-based clinical practice guideline (CPG) on ROE was launched in the Netherlands. In corroboration with a National Institute of Clinical Excellence (NICE) guideline (16), this Dutch ROE CPG strongly recommends a more risk-based approach because of the changing occurrence and skewed distribution of oral diseases in western European countries. Although the results of the present study should not be interpreted as indicating poor quality performance, because GDPs had not yet been exposed to the recommendations of the recent CPG, some conclusions may nonetheless be drawn. As the present study of GDP performance concerned a relatively healthy patient population presenting with good compliance scores, it appears problematic that most GDPs assigned routine recall intervals of 6 months, even though a majority of the GDPs in this study stated (11) that they assign variable recall intervals. The small proportion of recall intervals that deviated from the standard 6 months, consisted mainly of periods of 12 months. Moreover, this 'once a year' interval could be fuelled by the recent national reform of the public health insurance system in 2004 (excluding ROE and dental treatment for reimbursement), leading to patients waiting to visit dental practice once a year, irrespective of their risk for oral disease.
This study suggests that given the selected oral disease categories, patient's oral condition is not reflected in the assigned recall interval. Historically, GDPs are focussed on disease detection rather than on risk management. The complex and time-consuming process of identifying relevant risk factors and predicting oral disease are potential barriers for change in view of the lack of a gold standard for individual recall periods. Together with the substantial variation in clinical judgement and service provision among GDPs (17–21), the need for CPGs and risk-based training is obvious.
The most remarkable differences between clinical ROE performances and CPG recommendations existed in patient history taking, in patient communication/advice in the event of oral disease, in the record keeping of relevant items related to specific oral conditions and in the fixed or variable recall interval assigned. Despite the preventive purpose of ROEs in countries with very low prevalence of oral diseases, initial carious lesions in the 'caries-only' group were recorded in only a little more than half of the ROE cases. In the 'periodontal disease-only' group, periodontal pockets were recorded in less than half of the periodontal affected patients (Table 3). This seems in line with the relatively low percentage of patients for whom periodontal risk scores were assessed (Table 2) and indicates that performances need to be improved.
The explorative nature of this clinical case-recording study is, to our knowledge, the first large-scale prospective study in general dental practice concerning content and frequency of ROEs. It provides a better insight in individual ROE behaviour of GDPs, compared to data obtained from general ROE questionnaires (5, 11).
The ICCs identified from this study are relatively high compared to ICCs observed from other types of primary care research (22), indicating that the GDP behaviour may be rather decisive for patient outcomes. Moreover, the ICC values reported in this study may be used when designing future studies that use clustered sampling from primary dental care practices.

Several data sources, including their flaws, have been described that may be used to measure clinical performance, including medical record reviews, and health insurance company databases (23–25). The most significant advantage of clinical case-recording is the increased data yield resulting in a more complete clinical decision review (12). Structured record forms may guide GDPs in a directive way and might cause bias due to the structure and composition of the record forms. The relatively low participation among the GDPs eligible for the present study could be used to question the validity of our results. However, the actual GDP study group was compared with the non-participants, and significant differences between participating and non-participating GDPs were only found in the higher percentages of GDPs who stated that they assigned individualised recall intervals.

The results of this clinical study highlight a need for quality improvement. The initial training of GDPs should increasingly promote oral health screening focussed on risk management. The individual oral health condition of patients should be the reference point for the contents and frequency of a professional ROE and should be used to tailor variable recall intervals. GDPs should consider the individual risk of each patient, rather than using a standard approach. Patient factors should play a more pronounced role in recall assignment, excluding low-risk patients from standardised 6-monthly oral screening using a more CPG-based performance for patients at greater risk for oral disease. Questioning the approach of fixed recall periods could lead to professional debates and new research questions. Skills for risk-based management of ROEs should be implemented in undergraduate, as well as postgraduate, education. Dissemination of rigorously developed CPGs alone in primary care is barely effective; therefore intensive multifaceted implementation methods should be applied (27, 28).

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Chapter 5

Routine oral examinations in primary care: which predictors determine what is done?
A prospective clinical case recording study

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Abstract

Objectives

Elements of a routine oral examination (ROE) in dental practice may be determined by patients' oral status, as recommended by prevailing knowledge, as well as by other factors. Our aim was to identify patient and GDP characteristics associated with aspects of oral health assessment (OHA) and clinical management (CM) in patients with various oral conditions.

Methods

A prospective observational study was performed, based on clinical case-recording of 1059 ROEs by 128 GDPs. A clinical case-recording form was used to record oral health assessment, diagnoses made, and clinical management for each ROE. Multilevel logistic regression analyses (with random coefficients) were performed.

Results

Overall, 'patients age' in domains OHA as well as CM was the most salient predictor, while 'positive attitude to periodontal screening' showed to be a prominent GDP-factor. Patient characteristics mostly involved in OHA and CM were 'disease-free period' (Odds ratios from 0.21 to 0.66), 'oral health compliance' (Odds ratios from 0.32 to 0.65) and 'risk for periodontal disease' (Odds ratios from 1.79-4.97).
'Continuing professional development' (Odds ratios from 2.54 to 4.95), 'mean reading hours' (Odds ratios from 2.25 to 4.48) and 'cooperation with peers' (Odds ratios from 2.78 to 3.72) showed to be significant GDP-predictors.

Conclusions

ROEs are determined by patient oral health status, particularly by aspects of oral health compliance and risk for oral disease, but also by GDP characteristics. The latter may reflect perceptions of a professional role, which need to be considered in efforts to improve the quality of ROE in oral care.

Keywords

Routine oral examination, GDPs performance assessment, clinical practice variation, quality of oral care.

Introduction

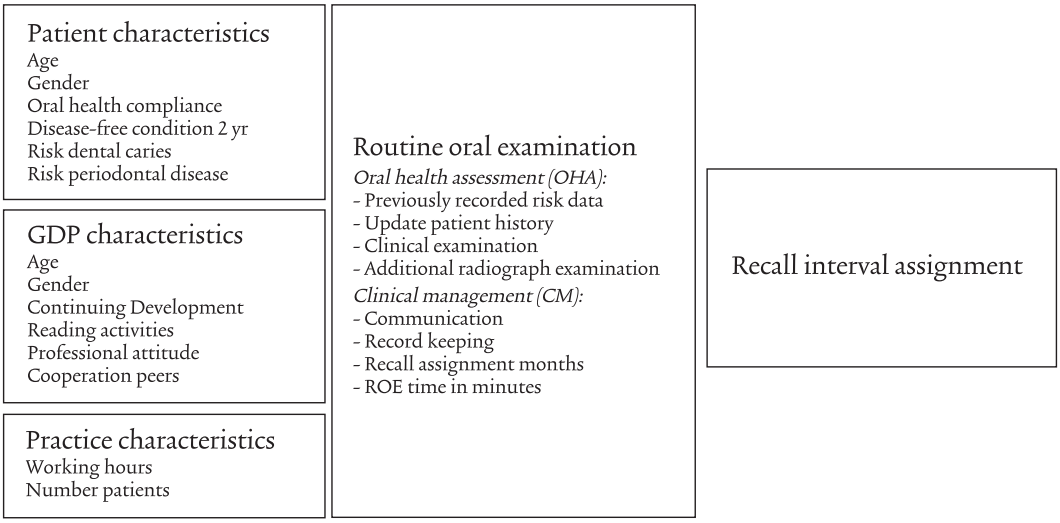
In most Western countries oral disease prevalence (caries and periodontal disease) is decreasing (1–3). The widespread use of fluoride (mainly in toothpaste) and increased patient preventive compliance for individual oral health care maintenance has resulted in improved oral health status and in the possession of more natural teeth in an aging population (4–8). However, most patients are still visiting dental practice for routine oral examination (ROE) on a standardised basis (9). As a result, six-monthly oral screening of relatively healthy patients is usual practice in developed countries (10, 11). However, it has been recommended to tailor the content and recall assignment to individual the patient's oral disease risk (12–15).

The main purpose of ROEs is to prevent oral disease and to manage further progression. The two main components of ROE are oral health assessment (OHA) and clinical management (CM). Identifying patients by means of individualised risk management for oral disease is critical. Unfortunately, the research evidence on risk factors for the onset of oral disease is limited, so risk assessment is mainly based on GDP's clinical judgements (16–18). Perhaps not surprisingly, ROEs are not only determined by oral health factors, as recommended, but they may also be influenced by other factors including dentists' diagnostic working style (19), availability of manpower in dentistry (20), practice characteristics, GDP's orientation in delivering oral care (21–25), patient's attitude towards oral care (26) and financial incentives organised in society (27).

Little systematic research has been done, however, on such factors. (28). Insight into these factors could help to target continuing dental education and quality improvement in general dentistry on relevant patient and GDP factors. Therefore, we used data from a large prospective clinical case recording study (11) to identify such factors (Figure 1).

The aim of this study was to identify patient-, GDP- and practice characteristics associated with OHA and CM by GDPs conducting ROEs in regular attendees with different oral conditions in daily practice.

Figure 1. ROE-model including content, recall interval and involved characteristics



Methods

An observational prospective study was performed, based on clinical case-recording by GDPs.

Study population

A convenience sample of 529 GDPs from The Data Station Project (DSP) of The Dutch Dental Association (NMT) (29), was invited to participate in a clinical recording experiment. This sample was recruited among a random group of 809 GDPs, who participated in the general ROE questionnaire in 2005. A total of 215 of them expressed their willingness to participate in this study; 131 of them completed the recordings. More than 80% of the Dutch GDPs are member of the NMT. Information on GDPs' personal and practice characteristics was obtained from the DSP study base.

Procedure

GDPs received an extensive instruction manual concerning prospectively inclusion of patients for this study. They were asked to select on a randomly chosen working day eight to ten consecutive patients scheduled for ROE, and to fill out a clinical registration form (CRF) immediately after completion of a ROE, to be performed exclusively by GDPs. Inclusion criteria for ROE-patients were: regular attendees for the last five years (at least once a year), and within a family only one member could be selected. Data were collected in June and July 2005. Information on the objectives of the study and instruction manuals for appropriate use were send to each GDP by mail together with ten recording forms. Participants were advised to practise with two forms before starting the actual recordings. The applicability of the recording form was tested in a pilot among ten experienced GDPs and time used per registration form was recorded. The average time per form was 5 to 6 minutes, resulting in an overall estimated time investment of 40-60 minutes per GDP.

Clinical registration form

A validated recording method was used for data collection (11). A CRF-form was developed, comprising specific domains and items potentially part of ROE. (Copies available from author TM). The rationale to use these specific domains and items was based on the results of a rigorous national RAND-modified Delphi consensus procedure with two expert panels in 2005 regarding content and frequency of ROEs (30).

Table 1. The mean percentage of routine oral examination (ROE) patients (n=1,059) for whom overall ROE domains (with number of items between brackets) were carried out, and associated 95% confidence intervals and intra cluster correlation coefficient (ICC)

GDP clinical performance (n=128)	**Mean (%)**	**(95% CI)**	**ICC**
Oral health assessment			
Previously documented data (2)	39.5%	(33.4-45.2)	ICC: 0.65
Update patient history (4)	55.9%	(52.4-59.3)	ICC: 0.51
Clinical examination (6)	95.9%	(95.9-97.7)	ICC: 0.25
Additional examination (1)	19.4%	(16.2-21.8)	ICC: 0.06
Clinical management according to current oral health status			
Communication (3)	24.5%	(22.5-26.6)	ICC: 0.20
Record keeping (8)	21.4%	(18.9-23.8)	ICC: 0.38
Recall assignment months (1)	7.00	(6.8-7.2)	ICC: 0.29
ROE time in minutes (3)	10.3	(9.5-11.0)	ICC: 0.49

Measures

A total of 28 ROE-related items (actions) were selected as dependent factors in the analysis, covering the following domains (Table 1):

- Oral health assessment (OHA) regarding: 'previously recorded data' (2 items), 'updated patient history' (4 items), 'clinical examination' (6 items), and 'additional examination' (1 item).
- Clinical management (CM) according to the current oral health status regarding: 'patient communication' (3 items), 'record keeping' (8 items), 'assignment fixed 6-montly recall interval' (1 item), and 'time investment' (3 items).

As independent variables were used:

- Patient characteristics (6 items): 'male', 'age', coded as 0-35; 36-55; or 56+ yr (reference group in analysis), 'oral health status' (disease-free at least two years), 'oral health compliance', 'dental caries risk' and 'periodontal disease risk' (Table 2).
- GDPs' personal, practice and clinical characteristics (8 items): 'male', 'age (> 50 yr)', 'continuing professional development activities (CPD)', 'reading professional and scientific literature', 'patient-related- and management working hours', 'number of patients in practice', 'peers working together within dental office', 'positive to systematic screening periodontal disease' (Table 3).

Patient characteristics were selected on the basis of the national RAND-modified Delphi consensus procedure on content and frequencies of ROEs conducted with expert panels (30) and GDPs personal and practice characteristics were selected on basis of previous research (10, 22-23).

Statistical analysis

Because of the two-stage sampling procedure (ROE patients clustered within GDPs), the confidence intervals (CIs) were corrected for design effect, and the intra-cluster correlation coefficients (ICCs) were calculated related to clustering of patients within GDPs (31). The ICC

is a measure of the relatedness of clustered patient data and based on the ratio of the variance between clusters of ROE patients (i.e. between GDPs) and the total variance (i.e. the variance between clusters of ROE patients plus the variance within clusters of ROE patients) (32). In our study a high ICC indicates a high degree of consistency within the GDP in performing a specific aspect of ROE. Dependent factors included 7 items for OHA and 18 items for CM. Separate logistic regression models were made for each dependent factor, including all potential predictors simultaneously. The predictors were 6 patient factors and 8 GDP- or practice factors (Figure 1). Statistical significance of regression effects was set at p=0.05.

Table 2. Characteristics of the ROE patient population (n=1,059), selected for multilevel regression (absolute numbers and percentages between brackets).

Patient characteristics	**n**	**(%)**
Gender		
Male	505	(48%)
Female	544	(52%)
Age		
0 - 35 years	362	(34.5%)
36 - 55 years	467	(44.1%)
56 +years	221	(21.0%)
Oral health status		
Disease free for at least 2 yrs	514	(48.5%)
Dental Caries	314	(29.7%)
Periodontal disease	139	(13.1%)
Dental caries +Periodontal disease	92	(8.7%)
Oral health compliance		
Good	622	(59%)
Moderate	398	(38%)
Poor	34	(3%)
Dental caries risk		
Estimated risk > 20%	269	(25.7%)
Periodontal disease risk		
Estimated risk > 20%	265	(25.4%)

Results

Patient population

Table 2 presents the numbers and percentages of patient characteristics at baseline such as gender, age, and mean attendance pattern and also when ROE-data recording was accomplished, the number and percentages of oral health status, estimated oral health compliance, estimated risk to develop oral disease and recall assessment. Fifty-two percent of the ROE observations were

from female patients (n=544). Three different age categories were identified, 0 - 35 years (35%), 35 - 55 years (44%), 56 years and older (21%), which represents in general patients' age groups visiting dental practice for ROEs.

Table 3. Personal, practice and clinical characteristics of participating general dental practitioners (GDPs) (n=128) and non-participants selected for multilevel regression in percentages or (mean) numbers and standard deviation (SD)

GDP characteristics	**Participants n=128**	**Non-participants n=347**
Personal		
Male(s)	107 (84%)	285 (82%)
Mean age in years (SD)	48.6 (7.3)	48.2 (7.6)
Percentage GDPs participating in CPD [A]	59.7%	51.7 %
Mean hours per month CPD	4.4 (3.7)	4.1 (2.4)
Mean hours reading professional and scientific literature/per month	6.7 (4.4)	6.2 (4.9)
Practice		
Mean total working hours/per week	38.3 (8.8)	
Mean patient-related working hours per week	31.3 (6.3)	31.9 (6.9)
Mean management hrs/per week	7.3 (4.6)	6.8 (4.2)
Mean number patients in practice [B]	2,716 (1,866)	2,757 (1,547)
Percentage GDPs working together with peers in practice	47.7 %	49.2 %
Clinical		
Percentage GDPs' positive to systematic screening periodontal disease [C]	65.6%	68,0%

A. CPD: Structured continuing professional development, peer review and professional visitation.
B. The number of registered patients attending the dental practice at least once a year.
C. Attitude of meticulous screening, monitoring and recording of periodontal disease condition.

GDP population

A total of 1070 patient recordings were conducted in clinical practice by the participating 131 GDPs. Three GDPs were excluded for further analysis for reasons of missing values. This resulted in 1059 observations conducted by 128 GDPs, and the mean number of registrations per GDP out of a maximum of 10 was 8.27 (SD = 0.73). From the participating GDPs, 84% (n=107) were male (Table 3). The mean age of the respondents was 48.6 years (SD = 7.3); the mean number of patients per practice was 2,716 (SD = 1,866). Within the DSP sample used for this study, no significant differences in personal and practice variables were observed between those GDPs who did participate in this case-specific recording study and those who did not (Table 3).
In the following paragraphs only the most notable results of multilevel regression analysis are presented concerning the sections 'oral health assessment', and 'clinical management' in response to the current oral health status (Table 1).

Oral health assessment

Previously documented patient data

A review of 'previously documented patient data' (medical and periodontal risk-scores) was overall performed in 39.5% of the patients (Table 1). In patient records, medical risk scores of males were less often recorded compared to female patients. In patients younger than 35 year of age, medical and periodontal risk scores as well as all updated patient history items were found less frequently (Table 4). When patients' oral health compliance was moderate to poor, previously recorded periodontal risk scores were more frequently found.

Female GDPs, GDPs who participate in CPD peer groups and GDPs with a positive attitude to systematic screening periodontal problems documented in previous ROE-visits more frequently medical as well as periodontal risk scores.

Update patient history

Overall, patient history was updated in 55.9% of the ROE patients (Table 1). With increasing age (>35 yr), patients were more often subjected to questioning about nearly all items. Assessments of medical health aspects continued to be done more frequently in patients of 55 years and older, while evaluation of 'problems and discomfort' and 'medical status' occurred more often in female than in male patients. Elevated risk for dental caries resulted in questioning social background, whereas an estimated higher risk for periodontal disease lead to more specific questioning of dental aspects (aesthetics and function). In patients with moderate to poor oral health compliance, items on medical and dental status (pain, function and aesthetics) were more frequently updated.

GDPs involved in peer group educational activities (CPD) updated more frequently their medical, social and dental patient records (Table 4), while GDPs 'positive to systematic periodontal screening' updated their medical and dental patient documents more often. In practices with more than one GDP, more attention was paid to exploring medical risks during OHA.

Additional examinations

Additional examinations (bitewing radiographs) were conducted in 19.4 % (Table 1). Patient characteristics did not determine differences in the prescription of bitewing radiographs. In practices with more than one GDP, prescription of bitewing radiographs occurred less frequently (Table 4).

Clinical management

Patient communication

Patient communication, i.e. information provided and advice was recorded in 24.5% of the ROE- patients (Table 1). General information and advice as well as feedback on oral hygiene and plaque removal were given more frequently in patients older than 55 year of age. When moderate to poor oral health compliance was found, oral hygiene feed back was given less frequently, while patients with a periodontal disease were subjected more frequently to guidance on oral

hygiene practices. In general, GDPs who worked together in group practices and who paid more attention to continuing professional development (CPD) adhered more to individual advice and feedback (Table 5).

Table 4. Significant Odds ratios (OR) with 95% confidence intervals of patient and GDP-characteristics resulting from regression analysis with oral health assessment ROE-*items as dependent variables*

Patient and GDP-characteristics associated with oral health assessment				
		Oral health assessment		
	Patient variables	**OR (95% CI)**	**GDP variables**	**OR (95% CI)**
Previously documented data				
Medical risk score	Age 36-55 yr	0.64 (0.41-0.46)	GDP male	0.62 (0.44-0.91)
(n=780; ICC: 0.72)	Age 35 years or younger	0.28 (0.17-0.46)	Continuing professional development	4.95 (1.36-18.14)
	Patient male	0.62 (0.44-0.87)	Systematic perio screening	5.95 (1.56-22.66)
	Disease-free 2 years or more	0.66 (0.45-0.95)		
Periodontal risk score	Age 35 years or younger	0.40 (0.24-0.66)	GDP male	0.07 (0.02-0.32)
(n=780; ICC: 0.64)	Disease-free 2 years or more	0.46 (0.32-0.66)	Systematic perio screening	9.91 (3.37-29.19)
	Risk periodontal disease	4.97 (3.06-8.07)		
	Oral health compliance	0.45 (0.29-0.69)		
Update patient history				
Problems/Discomfort	Age 35 years or younger	0.37 (0.21-0.64)	–	–
(n=780; ICC: 0.66)	Patient male	0.53 (0.37-0.78)		
	Disease-free 2 years or more	0.48 (0.32-0.71)		
Medical status	Age 35 years or younger	0.28 (0.17-0.46)	Continuing professional development	2.83 (1.19-6.72)
(n=780; ICC: 0.54)	Age36- 55 yr	0.36 (0.23-0.56)	Systematic perio screening	3.53 (1.45-8.57)
	Patient male	0.51 (0.37-0.72)	Cooperation peers practice	2.78 (1.10-7.06)
	Risk periodontal disease	1.78 (1.13-2.79)		
	Oral health compliance	0.65 (0.43-0.96)		
Social status	Disease-free 2 years or more	0.65 (0.45-0.95)	Continuing professional development	2.54 (1.11-5.80)
(n=780; ICC: 0.50)	Risk dental caries	1.94 (1.23-3.08)		
Dental status	Age 35 years or younger	0.41 (0.25-0.67)	Continuing professional development	3.64 (1.31-10.10)
(n=780; ICC: 0.62)	Disease-free 2 years or more	0.65 (0.45-0.92)	Systematic perio screening	3.27 (1.14-9.39)
	Risk periodontal disease	2.18 (1.35-3.52)	Mean reading hours/mth	4.48 (1.59-12.60)
	Oral health compliance	0.58 (0.39-0.86)		
Additional examination				
Bitewing radiographs	-	-	Cooperation peers practice	0.56 (0.34-0.92)
(n=780; ICC: 0.15)				

Record keeping

Overall, an average of 21.4% of the 8 selected items was recorded (Table 1). In general, updating records occurred significantly more in patients who were less compliant in maintaining good oral health and documentation habits decreased when disease-free conditions occurred. In records of patients older than 35 years of age, more often data were found on the amount of plaque, periodontal pockets, initial caries lesions, and oral health compliance.

GDPs who adhered to 'systematic periodontal screening', more frequently recorded nearly all selected items (Table 5), while dentists who were more supported by reading activities, documented their general patient files more frequently. In practices with smaller numbers of patients, more oral health compliance aspects were documented in records.

Recall interval type

The mean overall recall interval prescribed was 7.0 months (Table 1). Any systemic condition affected by oral disease and good oral health compliance as patient factors resulted in recall intervals of 6 months or shorter. GDPs characteristics were found not to be responsible for differences in type of recall interval.

Time investment

The overall mean time spent per ROE was 10.3 min (Table 1). 'Total time spent' and 'time spent on non-clinical aspects' increased in patients with elevated risk for periodontal disease, whereas a disease free condition caused less total time investment (Table 5). Time spent on 'clinical examination', was not predicted by patient characteristics. GDPs with a positive attitude to systematic periodontal screening spent in total more time on ROEs. Their time investment in minutes on 'clinical examination' and 'non-clinical ROE- aspects' was also higher. Furthermore, in practices were GDPs worked together with peers, and read more professional literature more than 5 minutes time was spent on clinical examination (Table 5).

Table 5. Significant Odds ratios (OR) with 95% confidence intervals of patient and GDP characteristics resulting from regression analysis with clinical management ROE items as dependent variables

Patient and GDP characteristics associated with clinical management				
		Clinical management		
	Patient variables	**OR (95% CI)**	**GDP variables**	**OR (95% CI)**
Communication				
General results OH assessment	Age 36-55 yr	1.71 (1.01-2.90)	Cooperation peers practice	3.72 (1.56-8.88)
(n=780; ICC: 0.39)	Disease-free 2 years or more	0.62 (0.39-0.96)	Mean reading hours/mth	2.25 (1.11-5.07)
			Continuing professional development	2.53 (1.14-5.62)
Subsequent treatment*	Age 35 years or younger	0.28 (0.10-0.79)	GDP older than 50 year	0.14 (0.04-0.56)
(n=149; ICC: 0.61)	Age 36-55 yr	0.32 (0.12-0.82)		
	Oral health compliance	0.32 (0.14-0.73)		
	Risk dental caries	2.72 (1.09-6.78)		
Oral hygiene Plaque	Age 35 years or younger	4.99(2.91-8.58)	-	-
(n=463; ICC: 0.36)	Age 36-55 yr	1.97 (1.23-3.15)		
	Oral health compliance	0.64 (0.42-0.99)		
	Risk periodontal disease	2.94 (1.86-4.67)		
Record keeping				
General update record	Oral health compliance	1.83 (1.20-2.80)	Systematic perio screening	2.93 (1.07-8.01)
(n=780; ICC: 0.58)	Disease-free 2 years or more	0.60 (0.42-0.86)	Mean reading hours/mth	2.80 (1.04-7.51)
Findings radiographs	Age 35 years or younger	0.18 (0.04-0.95)	-	-
(n=79; ICC: 0.74)	Patient male	2.87 (1.11-7.43)		
	Disease-free 2 years or more	0.21 (0.08-0.60)		

Initial carious lesions (n=140; ICC: 0.49)	Age 35 years or younger Age 36-55 yr Risk dental caries	2.75 (1.10-6.92) 2.58 (1.08-6.18) 2.41 (1.06-5.48)	Systematic perio screening	3.21 (1.15-8.91)
Amount plaque (n=469; ICC: 0.41)	Age 35 years or younger Disease-free 2 years or more	2.48 (1.45-4.26) 1.56 (1.04-2.35)	Systematic perio screening	3.77 (1.73-8.19)
Bleeding gingival (n=469; ICC: 0.29)	Risk periodontal disease	2.00 (1.29-3.11)	Systematic perio screening	2.73 (1.45-5.15)
Periodontal pockets (n=57; ICC: 0.42)	Age 35 years or younger Oral health compliance	3.27 (1.27-8.40) 0.36 (0.14-0.90)	-	_
Patient preferences (n=391; ICC: 0.48)	Age 35 years or younger Risk periodontal disease	0.42 (0.22-0.77) 2.52 (1.51-4.21)		
Oral health compliance (n=265; ICC: 0.47)	Age 35 years or younger Age 36-55 yr Disease free 2 years or more	2.85 (1.36-5.95) 2.19 (1.07-4.51) 0.39 (0.22-0.69)	Mean number patients	0.36 (0.13-0.92)
Recall interval (months)				
Recall (6mths or less) (n=780; ICC: 0.63)	Oral health compliance Disease free 2 years or more	1.80 (1.18-2.73) 0.29 (0.20-0.43)	_	_
Time spent min				
Total time spent (≥ 10 min) (n=777; ICC: 0.58)	Age 36-55 y Disease-free 2 years or more Risk periodontal disease	1.59 (1.05-2.42) 0.63 (0.45-0.88) 2.29 (1.55-3.38)	Systematic perio screening	4.10 (1.60-10.45)
Clinical examination (≥ 5 min) (n=777; ICC: 0.56)	_	_	Mean reading hours/mth Systematic perio screening Cooperation peers practice	2.64 (1.10-6.37) 2.79 (1.17-6.97) 3.72 (1.43-9.67)
Non clinical aspects (≥ 5 min) (n=777; ICC: 0.39)	Age 36-55 yr Risk periodontal disease	1.65 (1.10-2.48) 1.79 (1.20-6.03)	Systematic perio screening	3.08 (1.57-6.03)

Discussion

This study showed that the content of ROE was predominantly predicted by patient characteristics, as recommended by prevailing dental knowledge, but that also individual GDPs characteristics were substantially involved as well. Practice characteristics had little influence on clinical performance. Patient factors mostly involved in all ROE- domains were 'age', 'oral health condition', (disease-free and risk for periodontal disease), and 'oral health compliance', while 'positive attitude to systematic screening periodontal disease', 'cooperation with peers in practice' and 'CPD-activities' were the most prominent GDP predictors. Overall, the majority of items analysed concerning OHA as well as CM showed relatively high intra-cluster correlation coefficients, underpinning the substantial variation particularly between clusters of ROE patients (i.e. between GDPs). If ROE is seen as a 'patient-tailored systematic surveillance' approach, we would expect that patient characteristics like 'age', 'oral health condition', and 'oral health compliance' would be the most relevant determinants for ROE behaviour. Our results confirm this, suggesting that current practice is at least consistent with the prevailing insight in ROE. Our results

showed that GDP characteristics were associated with the content of ROE, which may suggest differences in working style.

Remarkably, patients' 'gender' emerged as significant patient factor in especially periodontal items of OHA. Since males and females were evenly distributed in the patient population, a different explanation is required for this result. On average, females are living longer than males with as a consequence that periodontal compromising conditions may occur more frequently in an aging population. A more preventive attitude in females may be responsible for this finding.

Based on previous research (10, 23), GDPs attitude towards periodontal screening showed to be a salient determinant of individualised assessment and assignment of variable recalls. In an elderly population (65% of the patients were older than 35 years of age), the risk of developing a periodontal condition is increased (7, 33). This study confirmed GDP-recording behaviour, especially by those GDPs with a positive attitude to systematic periodontal screening, regarding patients' factors like plaque accumulation, periodontal pockets, and oral health compliance. These GDPs also are inclined to register significantly more initial carious lesions, although a reliable screening system for dental caries activity and progression is not available for clinical practice. This systematic approach both for dental caries and periodontal disease is overall reflected in increased total time spend per ROE by this GDP- group.

The professional shift in daily practice from exclusively restoring the overwhelming number of decayed surfaces affected by dental caries in the last decades towards a more preventive individual screening of oral diseases (i.e. periodontal disease in an elderly population) besides caries, could be explain an altered professional role for GDPs.

Only in OHA, was a difference in behaviour found between female and male GDPs, the latter documented significantly to a lesser extent risk (medical and periodontal) scores in history files. Given the skewed gender distribution, results should be interpreted with caution. The population of GDPs was for the greater part males; used to perform ROEs based on routine practice patterns and not used to advanced medical and risk related record keeping. These routine practice patterns could also be responsible for the fact that GDP's age (clinical expertise) appeared not to be significant as a predictive factor in nearly all the ROE-domains assessed. Furthermore, routine practice working styles appeared to exert no significant influence on the selected practice characteristics (number of patients, mean working hours), which did not influence clinical behaviour in this study.

The most eye-catching GDP predictor in this study was a 'positive attitude to screening periodontal disease', which was reflected in nearly all domains. In combination with significant educationally related GDP-predictors like 'participation in peer group activities', 'reading professional literature' and 'cooperation in practice with peers' a specific group of practices is emerging where GDPs' clinical performance is based on 'systematic patient-tailored surveillance' (disease management). This clinical behaviour, reflected in more extensive OHAs, information and advice, prudent record keeping as well as time spent, looks like to be in accordance with recommendations of a recently developed evidence-based clinical practice guideline (CPG) on ROE (30). The CPG recommendations focussed on risk related individual assessments, however

the guideline was not yet implemented at the time this study was carried out. The number of GDPs in this study related to three out of four of these 'surveillance' predictors was 45 (35.7%), which means about one out of three practices. Noteworthy in this 'patient-tailored systematic surveillance approach' is that findings as a result of ROE (different risk level) eventually, were not reflected in the length of the recall interval assigned by this group. In this study, the type of recall interval, which could reflect a risk based assignment, was predicted by two patient characteristics only and no GDP characteristics were involved. This is in contrast with previous research (self-reported recall adherence in questionnaire surveys) suggested a strong correlation between 'positive attitude to screening periodontal disease' and variable assigned recall intervals (10). An explanation could be that this performance from about 70 percent of the GDPs (who stated to assign individual recall periods) is probably more driven by non-clinical factors like reimbursement and financial patient preferences than by individual oral health status. Applying more than one recall period (6 and 12 months), due abovementioned reasons, does not necessarily mean risk-based flexible recall interval assignment. These assumption looks like to be confirmed because patients with a good oral health compliance are relatively frequent assigned for a recall of 6 six months or less. Unfortunately, frequency of radiograph (bitewing) prescription over time to underpin risk-related clinical performance more explicitly could not be evaluated in this study, because the case recording was limited to one patient encounter.
Also, relatively few GDP predictors emerged in the communication domain, except for the factors 'CPD', 'reading professional literature', and 'peer cooperation within dental practice' and 'GDPs' age'. An explanation could be the small number of patients experiencing oral disease as a result of clinical examination (relative healthy population) and the low overall percentage and items scores in the 'information and advice' domain (11).
Obviously, our study had strengths and weaknesses. Prudent recording of multiple clinical data in general dental practice is in its infancy (11), and dental clinical records represents no reliable source for clinical performance assessment. The explorative nature of this clinical case recording study provides a better insight in individual behaviour of GDPs, compared to data obtained from general ROE questionnaires (23, 28). To measure clinical performance, several data sources, including their flaws, have been described, including medical record reviews, and health insurance company databases (34-36). Although not formally validated, it leads to reasonably valid recording. Alternative methods are self-reporting and clinical observation; the last method is suggested to be the gold standard (35, 37). The increased data yield is the most significant advantage of clinical case-recording with as a result a more complete clinical decision review (28). Structured record forms, used in this study, might probably guide GDPs in a directive way, causing bias due to the structure and composition of the record forms.
The present study showed a relatively low participation of the GDPs eligible, which could be used to question the validity of our results. However, the actual GDP study group was compared with the non-participants, and significant differences between participating and non-participating GDPs were only found in the higher percentages of GDPs who stated that they assign individualised recall intervals. Furthermore, GDPs are not familiar with practice-based

research, and probably they are reluctant to studies evaluating individual clinical behaviour. The results of this study highlight a need for quality initial training, continuing education, and quality improvement for GDPs to promote oral health screening focussed on a patient-tailored systematic surveillance approach. Structural medical and dental record keeping, evaluating previous recorded and actual patient history data are keynote factors for this approach in daily practice; physicians in general are not primarily focussed on recording medical data, because they feel it as non-medical work. Research to explore barriers for effective record keeping and recall assignment in daily practice should be promoted, with special attention to computerised clinical-decision support systems (38). Risk-based undergraduate education in dental schools should be promoted by training and assessments with the use of real life patients or electronically risk based patient vignettes. Simultaneously in general dental practice, intensive multi-faceted CPG-implementation methods should be applied (39, 40); after all only dissemination does not lead to change of behaviour (41, 42). Further research is needed in dentistry on implementation strategies to provide guidance for GDPs in selecting patients with different risk of oral disease, resulting in more appropriate and evidence-based oral care delivery. The results of this study give rise to conclude that:

- Patient characteristics 'age', 'oral health condition' and 'oral health compliance' predicted the greater part ROE performance, but individual GDPs and practice characteristics were also substantially involved
- A 'patient-tailored systematic surveillance approach' conducting ROEs showed to be not generally accepted in dental practice.
- This surveillance approach occurred mostly in practices where GDPs had a positive attitude to systematic screening, in practices where GDPs were working together, and in practices in which GDPs were more focussed on educational activities.

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Section III

Evidence-based recommendations

Chapter 6

Scientific literature on (cost)-effectiveness and risk assessment of routine oral examinations (ROEs)

Abstract

Objective

To search for scientific evidence on effectiveness, content and frequency of routine oral examinations (ROEs) in primary oral care as a part of structured guideline development procedure.

Methods

Initially, an electronic literature search was conducted to select relevant evidence on effectiveness aspects of routine oral examinations (ROEs). Search engines and databases used: Medline, Pub Med, and Cochrane Library, Cochrane Oral Health Group specialised trial register. Search Period: 1980–2005. Additionally, a literature search, focussing on existing systematic reviews and high quality studies was conducted in order to address risk management aspects of ROEs, concerning dental caries, periodontal disease, oral cancer, tooth erosion, third molars, and oral health promotion and advice. Finally, a third search was conducted regarding the prescription and frequency of bitewing radiographs. All retrieved citations and abstracts were assessed by two researchers independently, meeting predetermined inclusion criteria. Disagreements were resolved by discussion. Orthodontic treatment need studies were excluded from this literature search. Additional to these data, three relevant textbooks were screened.

Results

As a result of the search concerning effectiveness, two recently conducted systematic reviews (yr 2003, yr 2005) and a NICE clinical practice guideline (CPG) (yr, 2004) were identified, providing substantial actual research data. The search concerning risk assessment data and bitewing frequencies provided 256 abstracts and citations, which eventually resulted in 137 included studies. Overall, a paucity of good quality research data on effectiveness and risk management aspects of ROEs was found.

Conclusions

Insufficient evidence exists either to support or reject the practice of stimulating patients to visit the dentist every six months for ROE. The best available oral disease predictor applicable in general practice is previous disease experience. Individual differences in caries progression rates on proximal surfaces prevent precise timing of bitewing radiographs. Systematic prophylactic removal of asymptomatic impacted third molars is not based on reliable evidence. Risk-based screening for early detection of oral cancer may reduce morbidity and increase survival rates. Individual oral health education and advice showed to be beneficial to individual patients in clinical practice in reducing plaque levels in the short term.

Key words

Routine oral examination, cost-effectiveness, risk assessment, clinical practice guidelines.

Introduction

Evidence-based practice refers to 'practice that integrates evidence, clinical expertise and patient preference'. To summarise scientific information on effectiveness of ROE-items and recall intervals a systematic review, preferably of randomised study design, is the most used contemporary method. At the start of this research project, a systematic review on cost-effectiveness of ROE-recall periods emerged (1) as well as a NICE CPG (2) on ROEs in the United Kingdom. Extensive literature search strategies conducted in both reports were identical and provided consistent results. In Ireland, a Cochrane protocol emerged to conduct a systematic review (3) of randomised controlled trials on the effectiveness of ROEs, showing the increasing international interest concerning routine recall visits in general dental practice. At the same time, we were summarizing evidence (Cochrane review) concerning a content screening item of ROEs, namely systematic decision-making of prophylactic removal or retention of impacted disease-free third molars, a surgical procedure most frequently performed in young adults.
In this chapter, we present the results of the literature search on (cost)-effectiveness and risk assessment partly retrieved from both recently conducted systematic review (1, 3) as well as the NICE CPG (2), and completed with additional searches concerning risk management aspects and prescription of bitewing radiographs.

Methods

Initially, a literature search was conducted to select relevant evidence on effectiveness aspects of routine oral examinations (ROEs). Search engines and databases used: Medline, Pub Med, Cochrane Library, Cochrane Oral Health Group specialised trial register. Search Period: 1980-2005. The selection of scientific evidence was based on research towards primary studies, systematic reviews and clinical practice guidelines (CPGs), and focussed on individuals with deciduous, mixed and permanent dentition, and any type of routine examination of regular attending patients. Outcome measures were caries, periodontal disease, oral cancer and quality of life. Two researchers started with a search on systematic reviews and randomised clinical trials. Included studies and references were checked for relevant information. Text words used: 'dental attend', 'dental check', 'dental recall', 'dental visit', 'dental examination', 'dental frequency', dental interval', 'dental regular' and MESH terms: 'Dental caries', 'Tooth Diseases', 'Oral Health', 'Oral Hygiene', 'Preventive Dentistry', 'Tooth Diseases', 'Mouth Diseases ', 'Economics', 'Health care costs', and 'Cost and Cost analysis', 'Cost-Benefits analysis'. Additionally, a literature search was conducted, equally to the described strategy in the abovementioned NICE CPG, in order to address risk management aspects of ROEs. The combination of text words and MESH-terms applied, was: 'Dental Caries and risk assessment', 'Dental caries and progression', 'Dental erosion and risk assessment, 'Periodontal disease and risk assessment', 'Oral cancer and risk assessment', 'Third molars and risk assessment', 'Oral health promotion', and 'Oral health education'.
Finally, a literature search was conducted regarding the prescription and frequency of bitewing radiographs. The combination of text words and MESH terms used was: 'radiograph'; 'frequency', 'radiation'; 'x-ray'; 'bite-wing or bitewing', 'Radiography', 'Radiology', 'X-rays',

'Mandible', 'Maxilla'. All retrieved citations and abstracts were assessed by two researchers independently, meeting predetermined inclusion criteria. Disagreements were resolved by discussion.

Additional to these data relevant textbooks (Dental Caries, Fejerskov and Kidd 2003, Diagnosis and Risk Prediction of Periodontal Diseases, Axelsson 2002, Preventieve tandheelkunde, van Loveren and van der Weijden 2001) were screened. Orthodontic treatment need studies were excluded from this literature search.

Results

As a result of the narrowed search, two recently rigorously conducted systematic reviews (2003, 2005) and a NICE CPG (2004) were located. The latter comprised an updated, extensive search strategy of the 2003 systematic review on effectiveness, providing extensive actual research information and references. Both systematic reviews and the NICE CPG provided extensive up to date literature references. The search concerning risk assessment data and bitewing frequencies provided 256 abstracts and citations, which eventually resulted in 137 included studies. Overall, a paucity of good quality research data on effectiveness and risk management aspects of ROEs was found (Table 1).

Table 1. Overview scientific literature on effectiveness and risk management on routine oral examinations (ROEs)

	Effectiveness	**Risk assessment**						
Study type		**Dental caries**	**Bitewing radiography**	**Periodontal disease**	**Oral cancer**	**Tooth erosion**	**Third molar**	**Oral health education**
Systematic review, Cochrane, others	1, 2	16, 11, 19		95	99, 117		135	136, 137
Meta analysis		22			97			
Randomised clinical trials	5, 7				112			
Longitudinal		36, 37, 38, 43, 44, 45, 48, 49	70, 72, 73, 75	87, 90, 91, 92, 94				
Narrative review		35, 47	51, 52, 53, 54, 55, 56, 57,	10, 85, 86, 88, 89, 93, 96	101, 102, 104, 105, 106, 107, 114	122, 125, 126, 127, 132		138, 139,
Economics, Resource impact	4, 6, 8, 9							
Descriptive, cross-sectional, others		12, 14, 15, 18, 17, 20, 21, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 39, 40, 41, 42, 46, 50, 76, 77, 78, 79, 80	59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 71, 74	81, 82, 83, 84,	98, 100, 103, 108, 109, 110, 111, 113, 115, 116	13, 14, 118, 119, 121, 124, 128, 129, 130, 131	134	140, 141, 142, 143, 144, 145, 146
CPG, Evidence-based	3		58			120	133	
Total (n=146)	**9**	**44**	**25**	**17**	**21**	**16**	**3**	**11**

Clinical effectiveness

The systematic reviews focussed on the clinical and cost-effectiveness of ROEs on different recall intervals (1, 3). The Health Technology Assessment (HTA)-review (1) questioned the effectiveness of ROEs with different recall frequencies in improving quality of life and reducing the morbidity associated with dental caries and periodontal disease in children, adolescents and adults. The Cochrane systematic review (3), only directed towards randomised clinical trials, objected to determine the beneficial and harmful effects of different fixed recall intervals (for ROEs with different content).

The CPG (2) emerged in the United Kingdom was based on an updated search strategy of the literature conducted in the HTA-review (1). Eventually, both searches revealed 43 studies (29 in the HTA-review and another 14 in the NICE CPG). The majority of those studies focussed on the effect and the relationship of different recall intervals on several clinical outcomes for dental caries, periodontal disease, oral cancer and quality of life. The studies included were mainly cross-sectional and poorly reported, thereby limiting internal comparison between studies. There was no consistency observed on dental caries outcomes across 31 studies (for the greater part observational studies, only three controlled trials) in the direction of the effect of different recall intervals. No meaningful conclusions can be drawn from the available studies for dental caries as far as frequency of ROE is concerned. Ten observational studies investigated the relationship between recall intervals and periodontal disease outcome measures in the permanent dentition, also providing conflicting results. There was no consistency regarding the effect between studies of different ROE frequencies for the outcome measures gingival bleeding, probing depth/pockets, presence of plaque/calculus, bone score, gingivitis and periodontal health.

From a patients' perspective, few studies have investigated the effect of periodontal disease on quality of life. With regard to the relationship between oral cancer and recall frequency, a recent case control study showed that patients who never visited their dentist for oral examination had an oral cancer risk almost 12 times higher compared with patients visiting a dentist at least once a year, suggesting the relevance of regular ROEs for individuals at risk.

Four observational studies found weak evidence for the association of regular attendance with improved quality of life related to oral health condition. Due to the heterogeneity of populations, interventions, comparisons and outcome measures in these studies, conclusions should be drawn prudently.

Cost-effectiveness

Economic studies on the frequency of ROEs, mainly focussed on children rather than adults and did not exceed a timeframe beyond five years. Only one cost-effectiveness study was identified, which reported incremental costs of 73 US dollars per carious surface, comparing 12-monthly ROEs to no ROEs at all (4). Five resources impact studies (restricted to caries outcome measures) looked like to be consistent in that, with decreasing frequencies of ROEs (range 7-24 months), assessment and treatment time were reduced with little evidence of adverse impact on oral health (5-9). Decision analysis (Markov modelling) studies performed in the HTA-review as well as in

the NICE-CPG (both focussing only on dental caries) failed to draw reliable conclusions due to the lack of suitable data. Based on the available evidence, it cannot be concluded which interval is appropriate in terms of cost-effectiveness. The applied NICE-model demonstrates that cost-effectiveness varies across risk subgroups (more effective and cost-effective to assign shorter intervals in high caries risk groups and longer intervals in low caries risk groups) and therefore a more appropriate recall policy should be based on individual risk assessment.
The Cochrane systematic review (3) reported only one identified randomised clinical trial (5), meeting the inclusion criteria, with proved high risk of bias. Only limited data on children and adolescents for dental caries outcomes and economic cost outcomes were provided. Therefore, it was impossible to draw any conclusion regarding the potential benefits and harmful effects of altering recall intervals between ROEs. How patients value their oral health condition is still uncertain. Primary care research is needed to assess the relative cost-effectiveness of different frequencies of ROEs related to impact on dental caries, periodontal disease, oral cancer and quality of life.

Risk assessment aspects of ROEs

The type and frequency of ROE should be based on a patient's risk of developing disease or existing disease progression (2). Risk is the probability of an individual developing a given disease or experiencing a health status change over a specified period of time (10). Identification of patients with elevated risk for oral disease (by means of risk factors/indicators) can be of enormous importance to many aspects of prevention and management of a given disease in individuals (10). In order to perform a so-called risk assessment, it is essential for diagnosis of oral diseases to early recognise a lesion, its status, and progression (disease activity), and to know if more lesions will appear in the near future.
Risk assessment based on visual-clinical examination in combination with dental radiography aims to predict future oral disease and to prevent oral disease progression. This should be a necessary component in the clinical decision-making process of ROEs (11). However, the precise estimation of caries and periodontal risk is difficult (12), due to the etiological complex and multi-factorial disease process. In the last decade, another multi-factorial disease in oral health care appeared, i.e. tooth wear in children and adolescents the so-called tooth erosion (13, 14). For these main multifactorial oral diseases, a great number of different risk factors/indicators can determine individual patient's risk. In order to provide effective oral care, the need for individual risk assessment increases in populations with low oral disease prevalence.
The available evidence concerning risk assessment aspects on dental caries, periodontal disease, tooth erosion, oral cancer, third molars, as well as on the effectiveness of oral health education and frequency of bitewing radiographs is described in Table 1. This overview shows a paucity of randomised and longitudinal studies and comprised for the greater part of research of cross-sectional origin rather than prospective studies.

Caries risk assessment

In case of individual patients, the dentist should perform identification of caries risk factors. Using information readily obtained at a previous ROE, the assessment should be repeated every time a patient attends for ROE (2, 15). When assessing caries risk in conducting ROEs, the collected information should comprise: medical, social and dental history, dietary habits, use of fluoride, clinical evidence, oral hygiene, and salivary quality (11).
The best evidence (16) for items of patient's history in caries management exists for the use of fluorides. For diet, the applicable evidence is less strong and derives from population-based trials without randomization (17-19) as well as from descriptive studies (20). The applicable evidence for specific psychosocial items in individual caries management is lacking (15). Dental caries is a lifestyle-related disease of which the incidence is related to socio-economical circumstances (21).

Prevalence dental caries

The combination of several preventive measures, public oral health campaigns and routine dental visits, raised the public's' interest in oral health (22-25), resulting in decreased caries prevalence in most Western countries (26, 27). The prevalence of dental caries in children in The Netherlands belongs to one of the lowest worldwide; the average DMFT-score of 12-year-olds reached a minimum of 0.2 in 2002 (28-29). Caries prevalence (% of caries-free children) and caries experience (mean dmfs-scores) among 6-year-old children did not change significantly in the period 1996-2002 (30). The oral health of (young) adults also improved during the past decades resulting in a decrease of the number of people without natural teeth (from 31% to 18%) and in improved oral health conditions in all socio-economical strata (25, 26). For Dutch adults aged 35-44 yr the mean DMFT was 13.9 in 2004 (27) due to the caries epidemic three decades ago, with as a consequence lifelong oral care treatment by means of preventive and operative maintenance.

Caries prediction

The few prospective prediction studies were of poor quality, due to differences in populations; sample size and most of them were studies on the primary dentition (31, 32). It can be concluded that the predictive power of even the best outcome measures that are currently available is modest. More and higher quality, longitudinal, multifactor studies of risk indicators are needed to obtain strong support for their associations with caries incidence (32).
Based on scarce available evidence some prudent conclusions for clinical practice may be drawn. Caries can be predicted more accurately in infancy than in older age groups (33). The most consistent predictor of caries risk is past or previous caries experience i.e. clinical evidence of previous disease (11, 32, 33). Furthermore, the risk for caries in the permanent dentition increases considerably when previous caries experience in deciduous or mixed dentition occurred (34-37). Additionally, specific age groups are susceptible for disease onset. The incidence of new proximal carious lesions was considerably lower in young adults (20-27 years of age) than in adolescents (12-15 years of age) (38). Those who have an early caries disease experience have higher risk of disease onset like root caries on the age of 60+ (39). At the moment, clinical judgement of the

dentist and his or her ability to combine risk factors, based on their knowledge of the patient and clinical and socio-demographic information, is as good as, or better than, any other method of predicting caries risk. (11, 32).

Caries progression

The quality of identified research findings examining the rate of progression is limited, resulting in very broad and general conclusions (1–3). A small number of studies report on progression rates of carious lesions in enamel (mainly in children). Reliable studies reporting on progression rates of carious lesions in dentine are lacking. In general, the identified studies about progression of carious lesions are mainly cross-sectional in nature. The small number of prospective studies was of moderate methodological quality and focussed rather on children than on adolescents (11, 31). Dental caries progression or inversion depends upon the balance between demineralisation and remineralisation. This 'balance' is determined by the relative weight of the sums of pathological risk factors and protective factors (40). Looking at an individual level, progression rates vary considerably. Epidemiological data of lesion progression of representative populations are needed to make appropriate decisions regarding the probability an enamel lesion will progress into dentine over a certain period of time.

Looking at lesion progression at specific tooth surfaces, recent longitudinal data are lacking concerning occlusal surfaces (permanent molars), but progression rates of occlusal surfaces in first and second permanent molars were high between 1980–1986 (41, 42). Progression rates of free smooth-surfaces are unknown. Proximal tooth surfaces showed considerable differences in lesion progression between different surfaces (43). Overall, most of the data on lesion progression are based on mean values. Their relevance to individual risk assessment in practice leads to the following general conclusions:

The rate of caries progression in primary teeth is faster compared to permanent teeth (44-46). Lesion progression rates in dentine, suggest to be faster than in enamel (43, 47). In older adults lesion progression seems to be not related to age (48, 49). The rate of lesion progression in enamel seems to be slower in populations and individuals experiencing adequate fluoride exposure (50).

Timing of bitewing radiographs

Seven reviews (51–57) on timing and frequency of bitewing radiography were identified as well as one European CPG (58) with evidence-based recommendations on doses and risk and on the justification of X-ray examinations. The purpose of a bitewing radiograph, the most frequently used type of radiograph in primary oral care, is to detect carious lesions that are clinically hidden from a careful visual clinical examination and also to early assess periodontal bone breakdown. Visual clinical examination fails to detect a number of both occlusal and proximal carious lesions in primary as well as in permanent teeth (54). The prescription and timing (frequency) of bitewing radiography is related to the onset (early detection) and especially to the progression of dental caries. In using bitewing radiographs for early detection of proximal enamel and dentinal

lesions, 90% of the lesions were identified (57), while the detection of occlusal carious lesions is less accurate (57, 59, 60). The efficacy of bitewing radiographs depends on the refinement of the clinical caries diagnostic criteria, like information on cavitation and lesion activity (61). It was shown in a computer simulation model that clinicians' diagnostic ability (to avoid false positive decisions in the interpretation of bitewing radiographs) represents the most salient factor in achieving a health gain from restorative treatment of proximal surfaces (62).

Frequency of bitewing radiographs

Based on the European guideline recommendations, for adequately diagnosing proximal carious lesions, the timing and frequency of bitewing radiographs should be based on individual risk assessment (58). Risk assessment should include the number and extent of proximal lesions found at baseline taking into account different progression times (63-64). Consequently, the exposure for X-rays is kept a low as possible in order to minimise the radiation dose. The conclusions and recommendations from the identified literature on bitewing interval periods for different age- and risk groups showed a substantial variation.

Regarding the Dutch regular attendees experiencing very low caries prevalence, some conclusions about timing and frequencies of bitewing radiographs may be drawn:

Baseline radiographic examination at 5 years of age can give considerable diagnostic yield with regard to otherwise undetected proximal lesions in primary molars (65-66). Nevertheless, children with a negligible caries risk should be excluded at this age from baseline bitewing radiography (33). Bitewing radiography for proximal lesions in mixed dentitions should be considered at 8-9 years of age (58), depending on the analysis of individual risk factors involved. In case of a visually assessed caries-free mixed dentition successive bitewings could be delayed until the age of 10–14 years (50). A majority of children will benefit at that age from a baseline bitewing radiographic examination 1–2 years after the eruption of permanent premolars and molars (53, 68, 69). Several studies have shown that children at the age of 12–13 years with one or more proximal dentinal lesions or restorations showed a higher risk for developing new proximal lesions compared to those without lesions (43, 70, 71). Recent longitudinal studies conclude that proximal lesion progression rates in adolescents (12–15 years of age) compared to young adults (20–27 years of age) is 2 to 3 times higher. This seems to be in line with earlier findings that the initiation and rate of progression of occlusal and proximal carious lesions in permanent teeth are highest during the first few years after eruption (41, 73).

Additional bitewing radiography for adolescents should be based on an overall assessment of the individual caries risk. Progression of proximal carious lesions in permanent teeth is a relatively slow process and large numbers of lesions may remain apparently unchanged for longer periods (54).

In general, in an adolescent population exposed to optimal levels of fluoride and with a caries preventive programme, more extended intervals between radiographic examinations can be used than those prescribed in current guidelines (55, 79, 80). Median interval time of enamel lesion progression in adults from the inner enamel to the outer dentine can increase to more than 8

years (44). Intervals for bitewing radiographs in adults should also be scheduled individually. Risk assessment should include the number, extent and location of proximal lesions at baseline and rates of progression (63, 64). There appears to be no difference in progression rates between young and older adults (48, 49). Concerning root dental caries in elderly attendees, the natural history is largely unknown as the rate of progression through the root surface cementum (76, 77). New methods to be used routinely in clinical practice as adjunctive diagnostic aids to visual inspection, like laser fluorescence, light fluorescence, digital imaging, fiber-optic transillumination, and electrical conductance measurements, produce not enough evidence in caries diagnosis at this time to be recommended as a substitute for traditional diagnostic techniques (78, 79). At this moment the best diagnostic tools in cariology for clinical practice are visual inspection in combination with dental radiographs, i.e. bitewing radiographs (80).

Risk assessment periodontal disease

Worldwide, the prevalence of periodontal disease is difficult to estimate, because epidemiological studies of periodontal disease are characterised by a diversity of outcome measures used to describe and quantify them and the lack of consensus as to an uniform definition and classification (81). Probing pocket depth and attachment level are surrogate outcome measures for the determination of treatment need or -response. The effect of these uncertainties may over– and underestimate treatment need. In western industrialised countries with in general good oral health compliance, prevalence of aggressive periodontal disease is estimated to be between 5% and 15 % of the adult population (82). The primary risk factor for developing periodontal disease is plaque accumulation in the gingival margin (82), and also smoking and diabetes (84, 85). At an individual level, oral hygiene is much weaker as predictor of periodontal disease (86). This may be explained by the contribution of different risk factors, varying substantially between individuals. Some studies report a relation between genetic factors and the occurrence of aggressive periodontal disease (87). Some factors showing limited evidence for susceptibility for periodontal disease like osteoporosis, hormonal changes, psychosocial factors and high alcohol intake (84, 86). Repeated clinical examinations over a 26-year period (age span 16–59 years) in a cohort of well-educated man (who received regular dental care and practice good oral home care) have demonstrated that 25% went through adult life with healthy and stable periodontal conditions. However, 75% developed slightly to moderate periodontal disease with a cumulative mean loss of attachment of 2.4 mm at the age of 60. Only 20% of the sites continued to lose further attachment, less than 1% of the sites showed substantial loss of attachment more than 4.0 mm (87).
From a patients' perspective, few studies have investigated yet the effect of periodontal disease and quality of life (1, 2). Gingivitis is highly prevalent (50–90%) in most populations and might traditionally be a precursor to more severe periodontal disease (88–90). Little research has focussed on the effect of this condition on future oral health and quality of life and there is no evidence of causal relationship between gingivitis and periodontal disease (91).
Untreated periodontal disease is likely to progress faster than treated periodontal disease (92, 93). The progression of periodontal disease is hardly to predict, the multi-factorial origin underpins the need for an appropriate risk-based prediction model based on more longitudinal studies (94).

In a systematic review (95) clinical predictors concerning the progression of periodontal disease like bleeding on probing, the presence of residual pockets and furcation status were analysed in time to assess further attachment loss and tooth loss. Residual probing depths only seem to predict to some degree further progression of periodontal disease. Risk management and recall visits should be individualised and based on evaluation of patient's oral hygiene, disease activity, individual susceptibility and disease history (96).

Oral cancer risk assessment

Screening for oral cancer has to deal with a low predictive value due to the low prevalence of oral cancer in most developed countries. A recent meta-analysis of measures of performance reported in oral cancer and precancerous screening studies conclude that systematic examination of the oral mucosa has a high discriminatory ability (97).

There are a number of clinically identifiable precursor lesions (98). The world leukoplakia prevalence is 2.6% (99). There is a paucity of data on the prevalence and incidence of potentially malignant lesions. An increased risk of oral cancer is reported in males as well as females in the seventh and eight decades of life (100). Recently, in younger age groups (35–64 years) an increasing incidence has been reported (101). In virtually all age groups males have a two times higher risk for oral cancer than females (98, 100). Leukoplakia lesions, which show dysplastic or malignant transformation mostly occur on the floor of the mouth, lateral tongue and lower lip (102). A poor survival rate exists for oral cancer (50–56%) due to the late diagnosis at an advanced stage (103–106). Therefore, prognostic advantage is associated with early detection resulting in increased survival rate towards 80.5% (103) and has been consistently reported to reduce morbidity (107).

The main risk factors for development of oral cancer are tobacco use, excessive consumption of alcohol (108–110), chronic irritation of restorative interventions and previous experienced oral malignities (106, 111–112). Combined, they have a synergetic effect. Uncertainty exists about the influence of alcohol as an independent risk factor for oral cancer. In this context, evidence exists for the role of beer, wine and spirits, if heavily consumed (> 55 drinks a week). Due to the underestimation of individual alcohol intake, the effect of alcohol may be stronger than studies suggest (113). The lack of the usual risk factors for older patients in cases of oral cancer has been reported (113). It is also well known that outdoor workers are at greater risk regarding lip cancer because of the long-term exposure to ultra-violet daylight (114).

A prudent examination for oral cancer, including a thorough medical and social history and a systematic examination of the oral mucosa should be an integral part of all ROEs (110, 115, 116). Using visual examination as a screening method in the population can neither be supported nor refuted by evidence (117). Furthermore, evidence of the beneficial or harmful effects of screening methods like toluidine blue, fluorescence imaging or brush biopsy is lacking.

Tooth erosion risk assessment

In the last decade, besides dental caries and periodontal disease, tooth wear (tooth erosion) is emerging as a third complex multifactorial oral condition. Tooth wear is a more generic term

for describing loss of hard dental tissues. Often, a combination of processes may occur. In adults differential diagnosis is complex, although in children and adolescents the major cause of tooth wear is erosion (118). Tooth erosion, a progressive 'disease' of dental hard tissues, is prevalent especially in children and young adolescents (119–123). Tooth erosion is non-cariogenic loss of dental hard tissue. Erosion can be described as superficial loss of dental hard tissue by a chemical process without involvement of bacteria (124).
Research on the prevalence of tooth erosion in general populations is limited, due to the use of different scoring indices and different sample size in these studies. The data available suggest that males have a higher prevalence of tooth erosion than females, but differences in ethnic groups are not yet identified (125). The increased risk for dental erosion is associated with changing lifestyle factors, such as a shift in dietary habits. Consumption of low pH, sugar containing sports drinks, infant fruit juices and carbonated (citric acid containing) soft drinks (126, 127) and high consumption of citrus fruits are held responsible for progressive loss of hard tissue. Children and adolescents use more frequently erosive (sport) drinks, often in combination with excessive tooth brushing. The acids involved by erosion are not produced by oral flora, but arise from dietary (extrinsic factors), intrinsic factors (gastric acid reflux) or occupational resources (profession). The protective role of fluoride is unclear, suggesting only a limited protective effect (128–130). The characteristics of an erosive lesion are a polished appearance, cupping on incisal edges and occlusal cusps and loss of hard tissue on labial surfaces. The loss of tooth surface is disproportionate to the age of the patient. Most frequently the occlusal surfaces of the first permanent molars and the palatal surfaces of the maxillary incisors are affected. Prevalence studies report different outcomes. In The Netherlands, 30 % of adolescents of 15–16 years of age showed small erosive lesions and 11% showed at least one severe erosive lesion. In 2002, 15 to 27% of the 11–12 year old children in the Netherlands showed erosive lesions on first molars and upper incisors (123). In the United Kingdom, almost 60% of the 12-year old children suffered from dental erosion, with only 2.7% having exposed dentine (131). Careful diagnosis to identify aetiological factors and prudent history taking is a prerequisite to determine consumption patterns (131) including special habits (132).

Third molar risk assessment

The eruption process of third molars (wisdom teeth) is related to the completion of human dentition development and is as such an integral part of risk-based ROEs. Surgical removal of asymptomatic third molars is one of the most common surgical procedures performed in oral surgery in Western countries (133). In most cases, GDPs take standardised decisions concerning the prophylactic removal of wisdom teeth, mostly by patient referral to the oral surgeon. In 2000, a CPG in The Netherlands was developed (134) focussing on the prophylactic removal of asymptomatic mandibular third molars. The identified literature comprised mainly descriptive studies, three reviews, four longitudinal studies and one randomised clinical trial. The still ongoing international debate of the appropriateness of third molar surgical intervention in young adults was the main reason to conduct a systematic Cochrane review to identify high quality studies on the prophylactic treatment of third molars (135).

Effectiveness of oral health education and promotion

Two systematic reviews were identified on the effectiveness on oral health promotion (136, 137). The effect of current oral health educational methods and oral health promotion is questionable since some issues have been poorly researched (138).

Individual oral health education and advice (instruction of oral hygiene aspects and promotion of fluoride containing agents) showed to be beneficial to individual patients in clinical practice in reducing plaque levels in the short term (136, 139–142). An improved caries reduction in case of individual health promotion to use fluoride-containing agents, and oral hygiene instruction could alter patients' behaviour on the short term and one-to-one preventive advice and feedback are likely to be more effective compared to school-based health education. There is no evidence that mass media programmes significantly influences any oral health related outcomes (136). Nevertheless, the question remains which evidence-based oral health promotion and preventive approaches should be adopted by dental professional workers and the rationale for a alternative common risk factor approach in primary care addressing risk factors common to many chronic disease conditions in a wider socio-environmental context is advocated (143).

Despite the limited evidence on behavioural changes, the regular attendance patterns of patients in general dental practice for ROEs provides an unique opportunity for individual oral health promotion regarding effective oral hygiene (136), dietary habits (144), and smoking cessation (137, 145, 146).

General conclusions:

- The available evidence prevents any reliable conclusion on determining the optimal dental recall intervals based on cost-effectiveness. Insufficient evidence exists either to support or reject the practice of stimulating patients to visit the dentist every six months for ROE.
- The predictive validity of diagnostic needs for caries and periodontal disease may be fair on a population level, yet on an individual level they are difficult to apply.
- Reliable research on caries lesion progression is lacking and individual differences in progression rates on proximal surfaces prevent precise risk-based prescription of bitewing radiographs
- At this moment, the best available predictor applicable in general practice is previous disease experience
- Prediction of other multifactorial oral diseases, like periodontal disease or tooth wear are difficult to be determined, due to lack of reliable data
- The clinical judgement of the dentist and his or her ability to combine risk factors, based on knowledge of the patient and clinical and socio-demographic information is as good as, or better than, any other method of predicting caries risk
- Research produces not enough evidence at this time for any of the new diagnostic techniques for caries diagnosis to be recommended as a substitute for traditional diagnostic techniques (visual examination plus bitewing radiographs)
- Risk-based screening for early detection of oral cancer may reduce morbidity and increase survival rates despite the lack of evidence which screening method is most beneficial.

- Systematic prophylactic removal of asymptomatic impacted third molars as a result of ROEs is not evidence-based and some reliable evidence suggests that prophylactic removal of impacted third molars in adolescents neither reduces nor prevents late incisor crowding
- Individual oral health education and advice (instruction oral hygiene and promotion of fluoride containing agents) showed to be beneficial to individual patients in clinical practice in reducing plaque levels in the short term, reducing risk for the onset or progression of dental caries and periodontal disease.

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Chapter 7

Interventions for treating asymptomatic impacted wisdom teeth in adolescents and adults

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Abstract

Background

The prophylactic removal of asymptomatic impacted wisdom teeth is defined as the (surgical) removal of wisdom teeth in the absence of local disease. Impacted wisdom teeth have been associated with pathological changes. Several other reasons to justify prophylactic removal have also been given. Wisdom teeth do not always fulfil a functional role in the mouth. In most developed countries the prophylactic removal of trouble-free wisdom teeth, either impacted or fully erupted, has long been considered as 'appropriate care'.

Objectives

To evaluate the effect of prophylactic removal of asymptomatic impacted wisdom teeth in adolescents and adults compared with the retention of these wisdom teeth.

Search strategy

The following electronic databases were searched: The Cochrane Oral Health Group Trials Register (4 August 2004), the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE (1966 to 4 August 2004), PubMed (1966 to 4 August 2004), EMBASE (1974 to 4 August 2004). There was no restriction on language. Key journals were hand searched. An attempt was made to identify ongoing and unpublished trials.

Selection criteria

All randomised or controlled clinical trials (RCTs/CCTs) were selected comparing the effect of prophylactic removal of asymptomatic impacted wisdom teeth with no-treatment (retention).

Data collection and analysis

Assessment of relevance, validity and data extraction were conducted in duplicate and independently by three reviewers. Where uncertainty existed, authors were contacted for additional information about randomisation and withdrawals. A quality assessment of the trials was carried out.

Results

Only three trials were identified that satisfied the review selection criteria. Two were completed RCTs and both assessed the influence of prophylactic removal on late incisor crowding in adolescents. One ongoing RCT was identified.

Conclusions

No evidence was found to support or refute routine prophylactic removal of asymptomatic impacted wisdom teeth in adults. There is some reliable evidence that suggests that the prophylactic removal of asymptomatic impacted wisdom teeth in adolescents neither reduces nor prevents late incisor crowding.

Background

Wisdom teeth, or third molars, generally erupt into the mouth between the ages of 17 and 24 years (1, 2). More than other teeth, wisdom teeth often fail to erupt or erupt only partially (2). Impaction occurs where complete eruption into a normal functional position is prevented and completion of the root growth is fully established. This can be due to lack of space (in the mouth), obstruction by another tooth, or development in an abnormal position (3). A tooth that is completely impacted is entirely covered by soft tissue or covered partially by bone and soft tissue or completely covered by bone. Partial eruption occurs when the tooth is visible in the mouth but has not erupted into a normal functional position (4). An impacted wisdom tooth is called trouble-free if the patient does not experience signs or symptoms of pain or discomfort associated with it (5). The recent literature also refers to descriptions like 'disease-free' and 'asymptomatic' (6). Whenever impacted wisdom teeth cause symptoms of pain or pathological changes, such as swelling or ulceration of the gums, the tooth is no longer trouble-free. General agreement exists that removal is then an appropriate treatment decision (7).

The prophylactic removal of asymptomatic impacted wisdom teeth is defined as the (surgical) removal of wisdom teeth in the absence of local disease. Impacted wisdom teeth have been associated with pathological changes, such as inflammation of the gums around the tooth, root resorption, gums- and alveolar bone disease, damage of the adjacent teeth, and the development of cysts or tumours. Several other reasons to justify prophylactic removal have been given. Wisdom teeth do not always fulfill a functional role in the mouth and when surgical removal is carried out on older patients the risk of more postoperative complications, pain and discomfort increases (8-11). In most Western countries the prophylactic removal of asymptomatic third molars, either impacted or fully erupted, has long been considered as 'appropriate care' (9, 11). However, prophylactic removal of asymptomatic wisdom teeth may lead to considerable postoperative complications (10).

The prevalence of asymptomatic impacted third molars varies widely and is influenced by age, gender and ethnicity (12). Impaction of wisdom teeth in the lower jaw is more common than in the upper jaw (13). Most of the difficulties following surgical removal, such as postoperative morbidity, pain, discomfort and restricted activity, are related to lower wisdom teeth (14).

The low frequency of pathological changes related to impacted wisdom teeth has been used to promote a more cautious approach (6, 14). Health risks and cost-effectiveness of the prophylactic removal of asymptomatic impacted wisdom teeth should play a more prominent role in the decision-making process (15). Moreover, as the costs of surgical removal are significant (16), removal of asymptomatic impacted wisdom teeth that may remain disease-free indefinitely, produces an unnecessary burden on the healthcare resources (17).

There is a large variation among general dental practitioners in their management of asymptomatic impacted lower wisdom teeth (18). Prudent decision-making, with adherence to specified indicators for removal, may reduce the number of surgical procedures by 60% or more (6). It has been suggested that watchful monitoring of asymptomatic wisdom teeth may be an appropriate strategy (19). The decision-making process, regarding the prophylactic removal of

asymptomatic impacted wisdom teeth in the lower jaw, should be based on the best available evidence and combined with clinical experience. In addition, patients' perspectives, values and attitudes should play a prominent role (12).

Objectives

To evaluate the effectiveness of prophylactic removal of asymptomatic impacted wisdom teeth in adolescents and adults compared with the retention of these wisdom teeth. The following null hypotheses were tested.

(1) To test the null hypothesis of no difference in clinical effectiveness (in terms of clinical, biological, health related and quality of life outcomes) between surgical removal of asymptomatic impacted wisdom teeth versus retention of these teeth against the alternative hypothesis of a difference.

(2) To test the null hypothesis of no difference in cost-effectiveness of surgical removal of asymptomatic impacted wisdom teeth versus retention of these teeth against the alternative hypothesis of a difference.

Criteria for considering studies for this review

Types of studies

All randomised controlled clinical trials (RCTs) and controlled clinical trials (CCTs) comparing the effect of prophylactic removal of asymptomatic impacted wisdom teeth to non-intervention (retention).

Types of participants

Participants in the studies to be reviewed are individuals (adolescents and adults) with asymptomatic impacted wisdom teeth, and individuals in the same category who underwent prophylactic removal of asymptomatic impacted wisdom teeth. In the original written protocol the intention was to include only studies on adult participants (over 17 years of age). However, no suitable trials were identified. It was therefore decided to expand the remit to include studies on adolescent participants. The justification for this was twofold:

(1) Most people having their wisdom teeth removed are young adults; there is not much clinical difference between adolescents (14 to 17 years of age) and young adults (18 to 25 years of age);

(2) The existing clinical practice of prophylactic removal of impacted third molars following orthodontic therapy to prevent late incisor crowding.

Types of intervention

Trials comparing prophylactic removal with retention of asymptomatic impacted wisdom teeth.

Types of outcome measures

Types of outcome measures for hypothesis 1 and 2 are described in Table 1.

Table 1.

Primary outcome measures for hypothesis 1	
The Quality of Adjusted Life Years measure associated with	
retention	**surgical removal**
Pathological changes	*Pathological changes:*
Pericoronitis (inflammation of the gum around the crown of a tooth) Dental caries (tooth decay) Cysts Tumours Root resorption Dimensional changes in the dental arch (crowding).	Development of periodontal pockets distally to the second molars Dimensional changes in the dental arch.
Postoperative complications following delayed surgical removal	*Postoperative complications*
Biological: (temporary) (par)aesthesia (altered sensation) of the tongue and the lip infection of bone and/or surrounding tissues.	Biological: (temporary) (par)aesthesia (altered sensation) of the tongue and the lip infection of bone and/or surrounding tissues.
Health related aspects: pain and numbness days off work difficulty in eating and speaking.	Health related aspects: pain and numbness days off work difficulty in eating and speaking.
Primary outcome measure for hypothesis 2 Cost issues of treatment in local currencies.	

Search strategy for identification of studies

For the identification of studies included in, or considered for this review, detailed search strategies were developed for each database searched. These were based on the search strategy developed for MEDLINE (OVID), but revised appropriately for each database to take account of differences in controlled vocabulary and syntax rules. The MEDLINE search strategy combined the subject search with phrases one and two of the Cochrane Sensitive Search Strategy for randomised controlled trials (RCTs) . The subject search used a combination of controlled vocabulary and free text terms and is published in full in Box 1.

The following databases were searched:

MEDLINE (OVID) (1960 to 4 August 2004); EMBASE (1974 to 4 August 2004); PubMed was searched for RCTs using the 'related articles' feature; the Cochrane Central Register of Controlled Trials (CENTRAL), (The Cochrane Library Issue 3, 2004); the Database of Abstracts of Reviews of Effectiveness (DARE) (4 August 2004); the Cochrane Oral Health Group Trials Register (4 August 2004).

Box 1. Subject search for identification of studies

1. MOLAR, THIRD/
2. ("third molar$" or "wisdom tooth" or "wisdom teeth")
3. TOOTH, IMPACTED/
4. ((tooth or teeth) adj3 impac$)
5. TOOTH, UNERUPTED/
6. unerupt$
7. (1 or 2) and (3 or 4 or 5 or 6)
8. TOOTH EXTRACTION/
9. (extract$ or remov$)
10. asymptom$
11. trouble-free
12. or/8–11
13. 7 and 12

1. RANDOMISED CONTROLLED TRIAL.pt.
2. CONTROLLED CLINICAL TRIAL.pt.
3. RANDOMISED CONTROLLED TRIALS.sh.
4. RANDOM ALLOCATION.sh.
5. DOUBLE BLIND METHOD.sh.
6. SINGLE BLIND METHOD.sh.
7. CROSS-OVER STUDIES.sh.
8. MULTICENTER STUDIES.sh.
9. ("multicentre stud$" or "multicentre trial$" or "multicenter stud$" or "multicenter trial$" or "multi-centre stud$" or "multi-centre trial$" or "multi-center stud$" or "multi-center trial$" or "multi-site trial$" or "multi-site stud$").ti,ab.
10. MULTICENTER STUDY.pt.
11. latin square.ti,ab.
12. (crossover or cross-over).ti,ab.
13. (split adj (mouth or plot)).ti,ab.
14. or/1–13
15. (ANIMALS not HUMAN).sh.
16. 14 not 15
17. CLINICAL TRIAL.pt.
18. exp CLINICAL TRIALS/
19. (clin$ adj25 trial$).ti,ab.
20. ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or mask$)).ti,ab.
21. PLACEBOS.sh.
22. placebo$.ti,ab.
23. random$.ti,ab.
24. RESEARCH DESIGN.sh.
25. or/17–24
26. 25 not 15
27. 16 or 26

(NB: MeSH terms appear in upper case, free text terms in lower case).

Handsearching

Handsearching of the following journals was conducted by three authors (Dirk Mettes (TM), Marloes Nienhuijs (MN), Wil van der Sanden (WvdS)). A check was made to see which of the journals had already been searched as part of the Oral Health Group's handsearching programme.

A page by page search of the following journals was conducted for eligible studies: International Journal of Oral and Maxillofacial Surgery (1972 to 2003); Oral Surgery, Oral Medicine and Oral Pathology (1984 to 2003); Journal of Oral and Maxillofacial Surgery (1962 to 2003); British Journal of Oral and Maxillofacial Surgery (1963 to 2003); Journal of Cranio-Maxillofacial Surgery (1973 to 2003).

Reference sections in books on oral surgery and oral pathology were scanned to find relevant studies and proceedings of conferences were looked through in an attempt to identify unpublished studies.

Methods of the review

Study selection

Two authors (TM, MN) in duplicate, independently and in a non-blinded fashion, assessed the title, keywords, abstracts and/or the materials and methods section of results identified by the search strategy. Relevant articles identified by reference searching were obtained.

All articles selected by the authors were obtained. The articles on which the authors disagree were read in full and a decision to include or exclude was made upon discussion. Persisting disagreement did not occur. The criteria for inclusion were: study design (RCT, CCT), random allocation, comparison of prophylactic removal versus retention, and data on at least one of the selected clinical outcomes as a part of the primary outcome measure: Quality of Adjusted Life Years (health effects on adolescents and adults, economical effects and cost-effectiveness).

Quality assessment

The quality assessment of the included trials was undertaken independently and in triplicate by the three authors (TM, MN, WvdS) as part of the data extraction process.

Assigned quality criteria examined were:

(1) Allocation concealment recorded as: A. Adequate, B. Unclear, C. Inadequate, D. Not used, as described in the Cochrane Reviewers' Handbook version 4.2.

(2) Treatment blind to outcome assessors, recorded as: (A) Yes, (B) No, (C) Unclear.

(3) Completeness of follow up (a clear description for withdrawals and drop outs in each treatment group) assessed as: (A) Yes, (B) No.

After taking into account the additional information provided by the authors of the trials, studies were grouped into the following categories:

A Low risk of bias (plausible bias unlikely to seriously alter the results) if all criteria were met.

B Moderate risk of bias (plausible bias that raises some doubts about the results) if one or more criteria were partly met (these criteria were categorised as 'partly' in cases where authors had responded that they had made some attempts to conceal the allocation of patients, to blind the assessors or to give an explanation for withdrawals, but these attempts were not judged to be ideal).

C High risk of bias (plausible bias that seriously weakens confidence in the results) if one or more criteria were not met as described in the Cochrane Reviewers' Handbook, version 4.2.

Further quality assessment was carried out to assess the randomisation procedure, sample size calculations, the definition of exclusion/inclusion criteria, adequate definition of success criteria and comparability of control and treatment groups at the start of the trial.

Data extraction

The relevant data were extracted from the included study independently by three authors (TM, MN, WvdS). The following types of data were recorded: year of the publication, date and duration of the study, age of the participants, sample size, numbers of randomised to each group, and data on cost-effectiveness. Comparability of participants, interventions and outcomes at baseline were recorded.

The results were discussed between authors until agreement was obtained. In case of uncertainty the authors would have been contacted for clarification. Should this uncertainty still persist, the data were not been used in the review.

Data synthesis

It was planned to undertake sensitivity analyses to examine the effect of randomisation, allocation concealment and blind outcome assessment on the overall estimates of effect.

Data synthesis was only partly carried out due to inadequate reporting of the data in one trial (Lindqvist 1982). The Cochrane Oral Health Group statistical guidelines were followed together with calculation of relative risk values along with 95% confidence intervals. For continuous outcomes, means and standard deviations were to be used to summarise the data for both groups. Discrepancies in the estimates of treatment effects from the trials were assessed by means of the Cochran's test of heterogeneity. In case of a significant heterogeneity ($p< 0.1$), it was planned to re-assess the significance of the treatment effects by using a random-effects model.

Description of studies

Three randomised controlled trials (RCTs) met the review's inclusion criteria, of which one was ongoing. Table 2 and Table 3 provide the description of the included and ongoing studies.

Table 2. Characteristics of included studies

Study	**Harradine 1998**
Methods	Parallel group design. Two treatments groups, random allocation. Patients could not be blinded. Outcome assessor was blinded. 26% drop out for both study groups combined. Research aim: to investigate prospectively the effects of early extraction of third molars on late lower incisor crowding. Outcome measures: (1) Little's Irregularity Index (LII). (2) Intercanine width (ICW). (3) Arch length (AL). These measurements were registered at baseline and follow up. Differences between two time-points were calculated. Length of follow up: 5 years, mean length of follow up was 66 +/-12.6 months.
Participants	164 individuals entered the trial (55% were female), 77 individuals completed the trial (58% were female). Individuals who had previously undergone orthodontic treatment, but were no longer wearing orthodontic appliances or retainers. Orthodontic treatment comprised active treatment in the upper arch only with either removable appliances or a single arch fixed appliance, with no treatment or premolar extractions only being carried out in the lower arch. Individuals with crowded molars (third molars whose long axis and, therefore, presumed path of eruption was through the adjacent second molar). Baseline characteristics: reported for overall group sample, not per study group. Age of entry to the trial (mean+/- SD): 14 years 10 months +/- 16.2 months. Exclusion criteria: Residual premolar extraction space.
Interventions	Group I: Extraction of third molars (n = 44). Group II: Retention of third molars (n = 33).
Outcomes	Mean differences +/- SD change in LII, ICW and AL. For the upper arch no statistical differences were found between the two groups for the three outcome variables.
Notes	Sample size calculation: not described. Analysis (linear modeling) demonstrated no systematic differences between individuals who completed the trial and those who were lost to follow up. More specified characteristics per study group for comparability at entry would have been appropriate.
Allocation concealment	A – Adequate

Study	Lindqvist 1982
Methods	Split-mouth design. Aim of the study: to investigate whether third molars can contribute to the occurrence of crowding. Method of randomisation: not described. Patients could not be blinded. Blinding outcome assessor not clear. Sample size calculation: not described. Outcome measures: arch length (AL), the differences between the mean annual change in distances on the extraction side and the change on those in the control side over the total period of observation was calculated by means of cephalometric and casts analyses. Length of follow up: at least three years.
Participants	Inclusion criteria: patients with unerupted third molars. Total population consisted of 50% participants who have undergone interceptive orthodontic treatment during the mixed dentition only in the upper jaw. The other 50% received no orthodontic interceptive treatment at all. Exclusion criteria: none reported. Baseline characteristics: for the total study group, relative spacing anterior to the first molar was on average zero. Mean age at the time of operation: was 15.5 years (range 13 to 19).
Interventions	In 52 participants (29 female) a randomly chosen unerupted third molar was removed at one side, while the other non-extraction side was used as a control.
Outcomes	Not described by means of mean changes, standard deviations, P values and confidence intervals. Only reported as the calculated difference between the annual change on the extraction side and the change on the control side by means of slope values of the individual regression lines for the respective distances between reference points and planes.
Notes	No sample size calculation. Additional interventions in several patients (extraction upper jaw third molars and second molars). More baseline characteristics per study group at the start would have been useful. No description of withdrawals. Compensatory removal of the third molar of the same half of the upper jaw (n = 44) and second molars (n = 8) were reported and could alter the outcome of the trial.
Allocation concealment	C – Inadequate

Characteristics of the trial setting and investigators

Of the two included trials (Lindqvist 1982; Harradine 1998), one was conducted in Sweden and the other in the United Kingdom. One trial used a split-mouth design (Lindqvist 1982) and the other one a parallel-group design (Harradine 1998). The description of the type of impacted (unerupted) third molars included was different. Both trials included adolescents (14 to 18 years of age) with impacted third molars. Neither trial received any external financial support.

Table 3. Characteristics of ongoing studies

Study	**van de Waal 1999**
Trial name or title	Effects and costs of prophylactic removal of third molars versus removal according to morbidity.
Participants	Healthy participants aged 18 to 30 years with at least one mandibular third molar.
Interventions	Group 1: Prophylactic removal of third molars. Group 2: Third molars removed according to morbidity. The anticipated group size for the completed study are for Group 1: n = 100 and for Group 2: n = 400.
Outcomes	Prophylactic removal of third molars is associated with decreased functional health status for about a week, considerable healthcare costs and production losses in the majority of patients. So far, very few patients in the watchful waiting group have developed an indication for removal.
Starting date	*1999*
Notes	This trial has been stopped this year (2004)

Characteristics of the interventions

Both studies used the surgical prophylactic removal of asymptomatic impacted third molar as the treatment intervention.

Characteristics of outcome measures

Lindqvist 1982

Arch length (AL), defined as a straight line between the central fossa of the second lower molar and the incisal cross. The differences between the mean annual change in distances on the extraction side and the change on the control side over the total period of observation was reported by means of the slope values of the individual regression lines for the respective distances. Length of follow up: at least 3 years.

Harradine 1998

(1) Little's Irregularity Index (LII), defined as the sum of the contact points displacements from anatomic contact point to contact point.
(2) Intercanine width (ICW), defined as anatomical distal contact points of the lower canines.
(3) Arch length (AL), defined as the sum of the distances from the mesial contact of the first molar to the midline contact point of the first lower incisor.

These measurements were registered at baseline and follow up. Mean differences with standard deviations and 95% confidence intervals between two time-points were calculated. Length of follow up: 5 years, mean length of follow up was 66 +/–12.6 months.

Ongoing RCT 1999

This study was identified in The Netherlands, conducted in Amsterdam (van de Waal 1999). The research aim of this trial was to compare the effects and costs of prophylactic removal of third molars versus removal as a result of morbidity. Unfortunately, this RCT was discontinued recently for unknown reasons. The data were not available for analysis and contact with the researchers revealed that they still intend to publish the data and experiences in the near future (Table 3).

Table 4. Results of quality assessment

Study	Allocation	Blinding assessor	Withdrawals	Grade
Lindqvist 1982	No	No	Yes	C
Harradine 1998	Yes	Yes, Single	Yes	A

Methodological quality

The quality assessment of the two trials (Table 4) was based on an assessment of three criteria: allocation concealment, blinding and completeness of follow up.

Allocation concealment

The method of allocation concealment was considered adequate for one trial (Harradine 1998) and unclear for the other (Lindqvist 1982).

Blinding

In both trials it was impossible for patients and operators to be blinded to the intervention, but in one trial (Harradine 1998) the outcome assessor was blinded.

Completeness of follow up

In both studies withdrawals occurred. In one trial (Harradine 1998) the loss to follow up was described and did not affect the overall results. The split-mouth trial (Lindqvist 1982) did not report any losses to follow up, despite there being some.

Sample size calculation

Neither trial reported an a priori sample size calculation.

Randomisation

In one trial the randomisation method was not reported (Lindqvist 1982) and contact with the authors has not been successful. In the second trial (Harradine 1998) a list of randomly generated numbers was used and qualified as adequate.

Inclusion and exclusion criteria

Both trials used well described inclusion criteria.

Lindqvist 1982 included only adolescents (mean age 15 years and 6 months, range 13 to 19) with unerupted third molars in all quadrants. Half of them had undergone interceptive orthodontic treatment during the mixed dentition and the other half did not receive any orthodontic treatment. The total population (n = 52) comprised of 29 females (57%) at the start. The type of unerupted third molars of participants before inclusion was not described.
Harradine 1998 included adolescents (mean age 14 years and 10 months, standard deviation (SD) = 16.2 months) who had previously undergone orthodontic treatment. Treatment comprised of active treatment only in the upper jaw and with no treatment or premolar extractions only being carried out in the lower jaw. All participants (n = 164; 55% female) had 'crowded' third molars, that is third molars whose long axis and presumed path of eruption was through the adjacent second molar.

Comparability of control and treatment group at entry

Gender, age and orthodontic conditions (impacted molars, orthodontic treatment) were mentioned in both trials. In general both groups were comparable in each trial. More details about comparability of groups at entry would have been useful.

Results

The Lindqvist trial (Lindqvist 1982) was not able to predict which adolescent participants should have benefits or harms after the removal of impacted third molars with regard to late incisor crowding. The length of the arch increased in some participants while in others the arch length decreased during the observation period. On the average, the length of the arch in the whole sample did not change differently on the extraction side compared with the control side of the same patient. However, the length of the arch changed differently on both sides in most of the cases. The extraction side had a more favourable development than the control side in 70% of the cases. In 30% of the cases, however, the control side had a more favourable development. The difference varied between -0.4 mm and 0.8 mm (mean change: 0.16 mm) over the total observation period of at least 3 years. The relative frequency of positive and negative differences was in general the same in boys and girls. Clinical significant prediction which patients should react favourably to removal of the lower third molar in cases of anticipated crowding was not possible.
The other trial (Harradine 1998) showed no significant differences between both groups. For the data as a whole, there was a mean increase in incisor irregularity of 0.90 mm (SD = 1.99 mm), a decrease in intercanine width of 0.4 mm (SD = 0.78 mm) and a decrease in arch length of 1.5 mm (SD = 1.76 mm).
In participants where third molars were extracted the mean increase in incisor irregularity was 0.80 mm (SD = 1.23 mm) compared with 1.10 mm (SD = 2.72 mm) where they were not (p = 0.55). For the intercanine width there was no clinical or statistically significant difference. Regarding the arch length, there was a small but statistically highly significant (p = 0.0001) decrease in the arch length of the non-extraction group (2.1 mm) compared with the extraction group (1.1 mm). This greater decrease in arch length in the non-intervention group raised questions and could

not be matched with the lack of statistically significant difference in Little's index between both groups. Re-examination of the casts revealed that 39 of the recalled patients had undergone lower premolar extractions and it was apparent that some of the casts still had some slight residual extraction space at entry, which was not fully closed, despite absence of space being an intended criterion for entry into the study. Further analysis of these 23 cases was made excluding these to examine the possible effects of this factor. The analysis revealed a slight increase in the mean difference for Little's index of irregularity (1.1 mm) between the non-extraction group compared with the extraction group, but with values still within the 95% confidence interval (- 0.5 to 2.7 mm) and therefore not statistically significant (p = 0.15). The disparity in decrease in arch length was reduced to 0.7 mm mean difference in arch length between the two groups (p = 0.0035). Furthermore the data showed that for the upper jaw no statistical differences between the two groups for any of the measurements existed.

The conclusion drawn from this randomised prospective study was that the removal of impacted third molars to reduce or prevent late incisor crowding cannot be justified.

Discussion

This Cochrane systematic review focussed on randomised and controlled clinical trials on the effectiveness of removing or retaining asymptomatic impacted wisdom teeth in adolescents and adults. However, we identified only two completed studies, which were eligible for inclusion both of which only related to adolescents(i.e. aged 14 to 17 years inclusive).

The conclusion of the Harradine RCT on lower incisor crowding is relevant and related to orthodontic treatment stability, but solely based on one RCT with low risk of bias (grade A, quality assessment). Assessing from a quality of life perspective, the relevance of occurrence of lower incisor crowding to other mentioned pathological changes as possible outcome measures could possibly lead to the conclusion that crowding affects quality of life (it is not life-threatening) to a lesser extent than cysts and tumours do. On the other hand, this phenomenon is frequently seen and changing preferences of younger patients regarding aesthetical aspects of oral health may address more relevance towards a dentition without incisor crowding. Furthermore, neither of the two included studies reviewed, shed any light on patients' perspectives or on cost issues. Research in preferences of patients on these aspects is strongly advocated. No RCTs were identified related to prophylactic removal of impacted third molars in adults.

Nevertheless, the randomised clinical trial is the preferred study design for the assessment of the effectiveness of most health-care interventions. For several reasons, however, it may not be the ideal study design to investigate the justification of prophylactic removal, as opposed to retention, of impacted third molars.

First of all, in such a trial, the onset of disease is measured in the group of subjects in which the third molars are retained. A reasonable evaluation period to measure the prevalence of disease in the retention group would be 20 years, although relevant information may be apparent by 10 years. In the 10 years from the moment of inclusion, at about 20 years of age, most subjects are extremely busy and mobile. Many may move frequently between 20 and 30 years of age so

it is extremely difficult for a researcher to keep track of the participants and prevent them from being lost to follow up. Also the participants may become increasingly unwilling to be traced, examined or interviewed regularly. Funding of such long-term clinical trials is also assumed to be a substantial barrier to these trials. The fact that two RCTs (only focussed on stability of the dental arch) have been published on the effectiveness of retention and removal of impacted third molars may indicate that researchers anticipate experiencing severe problems regarding the continuity of such a study. Those researchers who endeavoured to start an RCT but failed to reach the endpoint may not have published their experiences, which will have caused publication bias.

Learning from 6 years-researchers' experiences, gathered within a RCT in Amsterdam (which has recently been stopped for unknown reasons), could possibly reveal relevant information about the complexity of a randomised study design in the case of removal or retention of impacted asymptomatic third molars.

Secondly, studies using a primary quality of (adjusted) life outcome measure, based on pathological changes (in case of retention) versus postoperative complications were not identified. The reason we choose this type of primary outcome measure is due to the difficulties of comparing the various outcomes, i.e. the rate of complications after surgical removal versus the incidence of pathological change in case of retention and the rate of complications due to delayed surgical removal (Song 2000). Using quality of life outcome measures is a relatively new research topic in dentistry. Less extensive literature is available, especially on longitudinal trials and measurement of change. Interpretation of change scores continues to be a challenge (20). Future research in this area has to deal with the question which oral health related quality of life measure is most appropriate to assign. In the meantime, to promote prudent decision making in daily practice the importance of utility methods by means of analysis studies is acknowledged. They provide more information regarding comparability of different outcomes.

The third molar controversy is still ongoing. Little agreement exists about the appropriateness of prophylactic removal of asymptomatic impacted third molars and the debate yields controversial statements (21). The key question in the debate remains: why should impacted wisdom teeth be removed in the absence of symptoms or pathological conditions? If we had the ability to reliably predict future development, prophylactic removal would perhaps be unnecessary (22). However, reliable estimates of the onset of pathology related to non-intervention for impacted third molars are modestly unavailable (23), due to the widespread practice of routine removal over the past decades. The little information on the prevalence of pathology related to third molars in older patients suggests that the prophylactic removal of all impacted third molars at pre-adulthood may not be justified. Non-intervention outcome studies are rare due to the problems associated with a complex long-term prospective study design (24). Explicit record keeping and a systematic registration of the fate and natural course of impacted wisdom teeth in adolescents and adults (where possible collected in national databases) could provide within a relative short period of time clinical data to boost the discussion and elaborate appropriate study designs on this controversial topic.

Conclusions

Implications for practice

In the absence of more data from randomised controlled trials (RCTs), dental clinicians and oral and maxillofacial surgeons could improve their decision-making by using contemporary evidence and clinical expertise contained in well-designed national clinical practice guidelines (25). Existing multi-disciplinary clinical guidelines (13, 17) should focus on aspects like consistent clinical and radiographical examination and diagnosis in all individuals from the age of about 18 years. The dental clinician, who examines healthy individuals in the course of assigning a recall interval, should be responsible for monitoring third molars in recurrent communication with patients and where there are more complex cases, with the oral and maxillofacial surgeon as a consultant. Special attention should be paid to the onset of pathology, based on explicit terminology and definitions, the monitoring and registration of morbidity and quality of life aspects (i.e. patients' perspective, values and attitudes). Clinicians should make it clear to adult patients with asymptomatic third molars that there is no evidence one way or the other about the benefits or otherwise of removing these molars. The same communication strategy to adolescents and their parents regarding the impact of surgical removal on late lower incisor crowding should be advocated.

Implications for research

There still is a need for long-term and well-designed prospective studies of asymptomatic impacted third molars. To solve the problem of comparability an overall oral health related outcome measure is advocated. In the absence of better-designed randomised or controlled clinical trials, observational studies (focussed on specific outcomes) could provide the best available evidence to support or refute the effectiveness of the removal of asymptomatic third molars. To gain an insight into the (cost)-effectiveness of retention versus prophylactic removal of asymptomatic impacted third molars existing decision analysis model studies to compare outcomes could be used. Further research in decision analysis models is advocated and patient's preferences and views should be an essential part of this research.

This review concludes that no reliable evidence was found to support or refute routine prophylactic removal of asymptomatic impacted wisdom teeth in adults. There is some reliable evidence that suggest that the prophylactic removal of asymptomatic impacted wisdom teeth in adolescents does not reduce or prevent late lower incisor crowding.

Potential conflict of interest

The participating authors declare that they have no financial conflict of interest, nor do they have any associations with industry regarding the subject of this review.

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Section IV

Enhancing patient-tailored risk management

Chapter 8

Routine oral examination: Development and use of risk-based patient vignettes as a tool for continuing professional education

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Submitted

Abstract

Objectives

To develop, by conducting a RAND-modified Delphi procedure, content for an on-line decision support system of patient vignettes to use as an educational tool for a patient-tailored risk strategy on routine oral examinations (ROEs), and to test and implement the model as a tool in dental education.

Methods

A Content Management System (CMS) was provided, comprising conclusive data of a structured literature search and 27 ROE patients which were selected on predefined criteria. A RAND-modified Delphi consensus procedure was conducted with 31 experts divided into two expert groups (age group: ≤ 18 yr and > 18 yr). Initially, online assessments of 21 selected risk factor/indicators per ROE-patient were conducted, eventually leading to 19 patient vignettes covering all relevant risk combinations and age categories. For each patient vignette, all relevant clinical and non-clinical data were provided. Judgements were collected concerning risk level, ROE content, bitewing frequency and assigned recall interval. Feedback related to scientific evidence on different ROE domains was provided. Total time investment per expert was recorded. Finally, a pilot with 35 experienced GDPs was conducted to assess the appropriate use of the model for continuing professional development (CPD). The scores emerged by GDPs' assessments concerning decisions on bitewing frequencies and recall interval were compared with national expert opinions.

Results

In total 19 online patient vignettes were developed covering both age groups and stored in the CMS. Consensus was reached with regard to content of relevant screening items, bitewing frequency and recall interval. Substantial differences in assessment scores between experts and peer groups were found concerning recall length in low risk patient groups.

Conclusions

Risk-based patient vignettes regarding risk management tailored to recall interval assignment and bitewing radiograph timing provide a promising computer-assisted learning instrument for CPD as well as undergraduate education. Further long-term research is needed to deliver more data on the reliability of these set of patient vignettes.

Keywords:

Routine oral examination, risk assessment, decision-support systems, quality of oral care, continuing professional development.

Introduction

Nowadays, the prevalence of dental caries in the Netherlands belongs to one of the lowest in Western Europe (1, 2) and recently, a more patient-tailored risk strategy in dental practice has been advocated (3, 4). The aim of this strategy is to discriminate between high- and low-risk individuals by assessing risk and by predicting future disease onset and progression as an integrated part of clinical decision-making (5, 6). Evidence-based routine oral examination (ROE) is also directly related to the planning of appropriate preventive interventions both for caries and periodontal disease, influencing the provision of oral care (recall frequency) and reducing the burden of restorative treatment (7). Unfortunately, there is a paucity of randomised longitudinal studies on patient-tailored risk-based recall intervals in clinical practice (3, 8).

Little is known about the appropriate content and frequency of ROEs conducted in patients with different risks for oral disease, whereas general dental practitioners (GDPs) still assign traditionally standardised recall periods for all regular attendees (9, 10). As a result, GDPs are being confronted with new patient-tailored surveillance approaches, while they are not educated to select systematically high- and low-risk patients groups. Moreover, looking at the variation within the dental profession regarding clinical judgement (11–16), a patient-tailored risk strategy in performing ROEs should be enhanced by means of implementation programs such as continuing professional education with counselling and feedback.

An educational system (instrument), both for under- and postgraduate training, could provide guidance and training in selecting ROE patients and also offer an assessment tool for clinical performance. Therefore, a representative set of risk-based patient vignettes was designed. Stored in an on-line Content Management System (CMS), these vignettes were used as a clinical decision-support system (17). Patient vignettes have been found to be a reliable instrument to assess and guide clinical decision-making (18-21) in case evidence showed to be inconclusive.

The aim of the study was twofold:

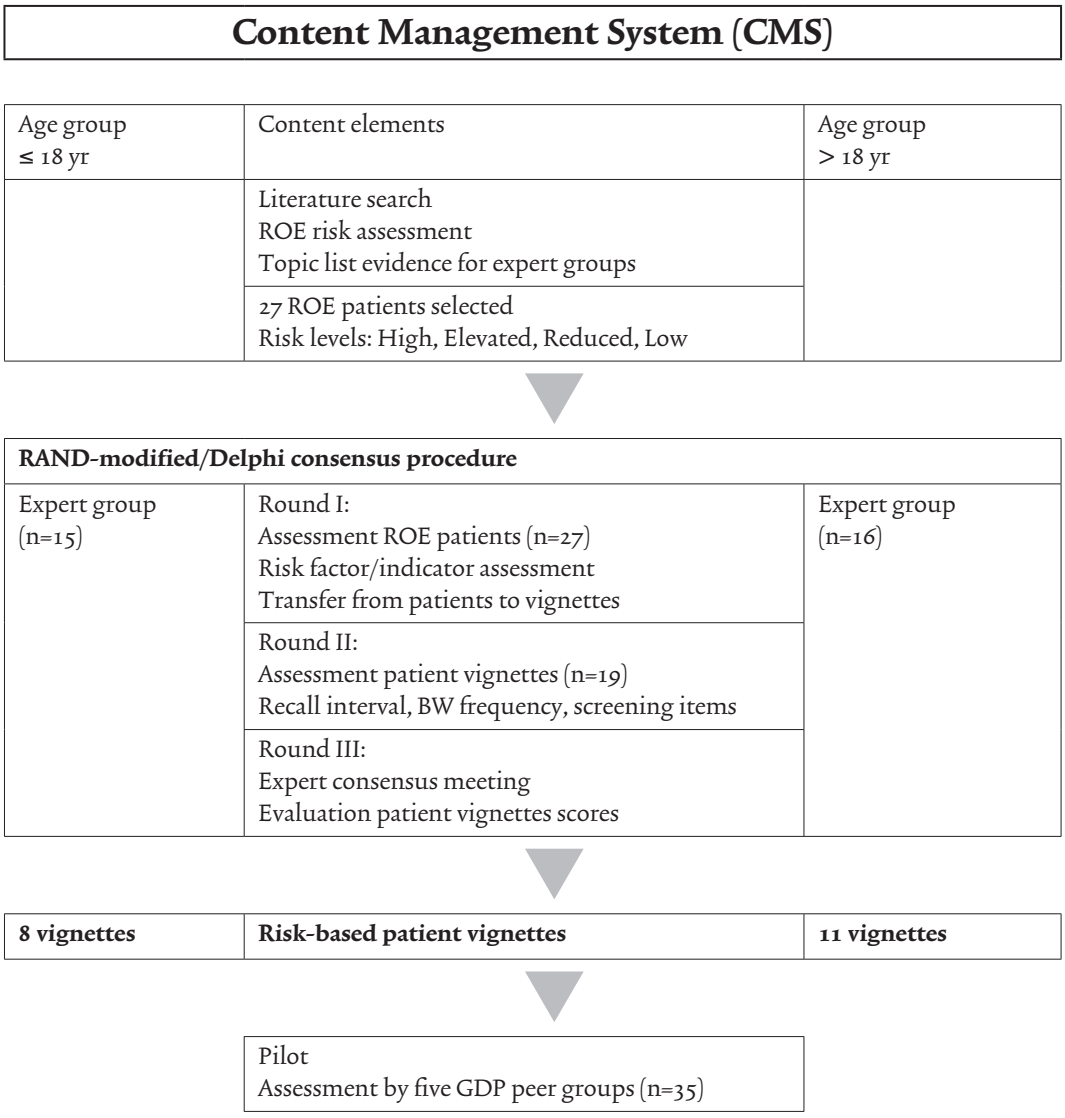
(1) To describe the development of a set of risk-based patient vignettes for ROE decision-making

(5) To test the CMS as a tool for a patient-tailored risk strategy in a pilot experiment for continuing professional development (CPD).

Material and methods

In order to compose the clinical and scientific content for the CMS, representative ROE patients from daily practice were selected and a literature search was conducted covering all relevant risk aspects of ROEs to provide an evidence base. The 27 ROE patients selected were extensively documented and concise conclusions retrieved from the literature search per ROE domain were stored in the CMS. A structured e-RAND-modified Delphi consensus procedure was conducted with two expert groups to develop a set of risk-based patient vignettes (Figure 1).

Figure 1. Development procedure risk-based patient vignettes concerning routine oral examination



Content management system (CMS)

A web-based content management system (CMS) was constructed, comprising the specific requirements with respect to feasibility and clarity of the different clinical and non-clinical components of a CMS. A pilot was conducted with the involvement of six experienced dentists (≥ 10 yr in practice). Before starting the procedure, experts were facilitated to login with a provided username and password. Extensive instructions were given in an online manual and a try-out ROE patient with individual feedback was completed. Individual counselling, in case of technical problems using the CMS, was provided either by e-mail or by telephone.

Box 1. Definitions of ROE patient, patient vignette and risk profile as well as predefined risk levels of patient vignettes for dental caries and periodontal disease

Definitions		
ROE patient	Represents a clinical case with extensive description of clinical and non-clinical patient characteristics (personal, patient history, clinical examination and additional examination data) of regular attendees (individuals).	
Patient vignette	A vignette represents a specific patient age group, whose risk factors for oral disease and clinical and non-clinical patient characteristics are for the greater part similar. Per vignette a risk profile is described with experts' opinions for the type and number of screening items, the frequency of bitewing radiographs and the assigned recall interval.	
Risk profile	A risk profile is a predefined level of risk for oral diseases as a result of exposure to certain risk factors.	
Predefined risk levels		
	Dental caries	*Periodontal disease*
High	Presence of (recurrent) active carious lesions, and increment of ≥2 new, progressing or filled lesions a year or ≥ 1 new lesion a year in subsequent years. Risk factors may not totally be changed or may partially be unknown.	Presence of (recurrent) active and progressing periodontal lesions (bleeding on probing, generalised attachment, vertical bone loss, root furcation defects, multiple pockets >5 mm). Risk factors may not totally be changed or may partially be unknown.
Elevated	Presence of active carious lesions, or increment of 1 new, progressing or filled lesions after a period of reduced or low risk. Risk factors can potentially be changed.	Presence of maximum 2 localised active periodontal lesions (bleeding on probing, no vertical bone loss, minor attachment loss with shallow pockets 4-5 mm). Risk factors can potentially be changed.
Reduced	Previous disease experience, no active lesions or restorations due to caries in preceding 2 yrs or more. Risk factor surveillance	Previous disease experience, no active periodontal lesions, no disease progression in preceding 2 yrs or more. Risk factor surveillance
Low	No caries experience Risk factor surveillance	No periodontal disease experience Risk factor surveillance

Content elements

Literature search

A literature search was conducted to identify evidence on relevant domains of ROEs. The selection of scientific evidence was based on research towards primary studies, systematic reviews and relevant evidence-based clinical practice guidelines (CPGs). Topics concerned were: the effectiveness of ROEs, risk management of dental caries (potential risk factors) and of periodontal disease, oral cancer, dental erosion, and third molars. Furthermore, evidence on oral health

promotion and education, evidence on the prescription and frequency of (bitewing) radiographs, recall interval assignment and patient preferences towards ROEs were addressed. An extensive description of the combined search terms (text words and MESH-terms) used is available by the authors. Additional to these data relevant textbooks were used (22, 23). Search engines and databases used were: Medline, Pub Med, Cochrane Library, and Cochrane Oral Health Group specialised trial register. The search period comprised 1980-2005. The studies retrieved from the evidence-based literature search were critically appraised and selected by the research group and conclusions were summarised in a ROE evidence-topic list.

Table 1. Set of 21 risk factors/indicators from literature and selected risk factors for patient vignettes after RAND-modified Delphi procedure for each age group (☐)

Selected risk factors/- indicators		
Based on literature search	**Selected in vignettes**	
	≤ 18yr	**> 18 yr**
Dental plaque	☐	☐
Oral hygiene	☐	☐
Gingival bleeding	☐	☐
Caries primary dentition	☐	☐
Number of new carious lesions	☐	☐
Number of restorations	☐	☐
Fissure morphology		
Root surface exposure		☐
Crowding anterior teeth		
Pockets/attachment loss		☐
Tooth loss (missing teeth)		
Motivation/oral health compliance	☐	☐
Fluoride intake	☐	☐
Smoking habits		☐
Dietary habits	☐	☐
Education/income (parents)	☐	
Saliva		☐
Systemic disease		☐
Genetic factors		
Medications		☐
Type bacterial flora		☐
Total (n)	**10**	**16**

Selection of ROE patients

The ROE patients for two different age groups (≤ 18 yr and > 18 yr) were selected based on four predefined risk levels for dental caries and periodontal disease (Box 1). The rationale for these risk levels was based on the evidence related to 'past disease experience', considered as the best available predictor for future disease onset (24).

All clinical cases to be assessed, comprised the most relevant clinical and non-clinical features and characteristics, visualised by means of extensive descriptive information like 'Personal and patient history data', 'Attendance record', 'General health status', 'Social status', 'Dietary habits', 'Oral hygiene', 'Clinical examination' and 'Additional examination'. Furthermore, detailed description and illustrative pictures and photographs of the oral cavity simulating real life clinical conditions were provided. Based on the available handbooks and literature search, all potential risk factors related to above-mentioned oral diseases were selected. Each age group, children/adolescents versus adults, has its own set of risk factors (25). The CMS contained 21 potential risk factors/indicators for oral disease (Table 1). In total 27 ROE patients of different risk profiles were developed covering both age groups. The assignment for both expert groups was to assess the relevance of each risk factor/indicator with regard to 13 '≤ 18 yr' patients and 14 '> 18 yr' patients, respectively.

E- RAND-*modified Delphi consensus procedure*

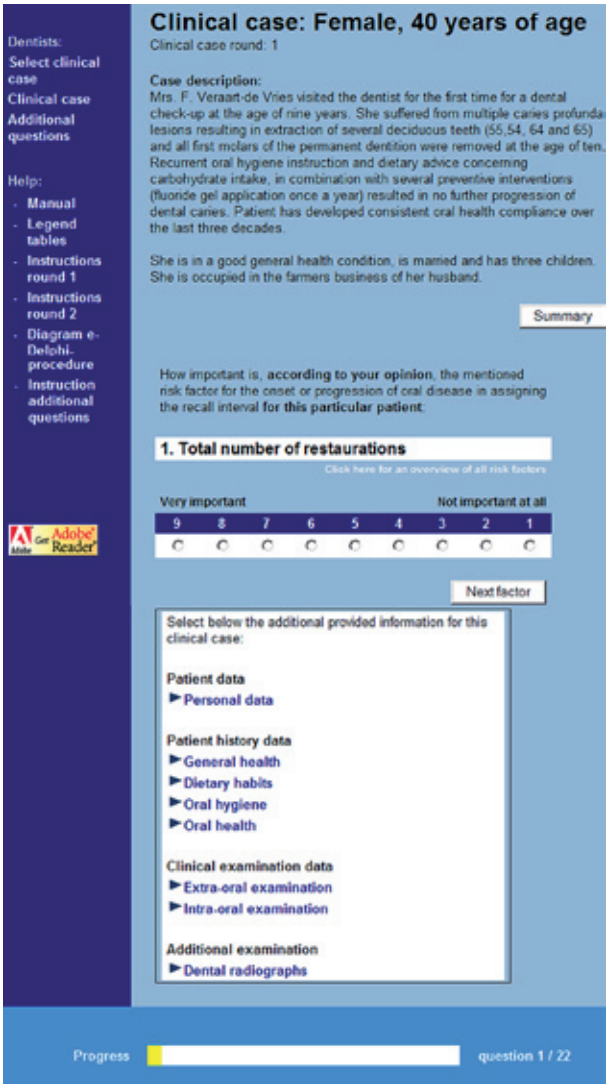
Procedure

In developing the risk-based patient vignettes a validated e-RAND-modified Delphi consensus procedure was used. This method has been extensively validated and is especially useful when the available scientific literature does not provide sufficient indications for rating the appropriateness of medical or dental procedures (26-34). It represents an evidence-based structured formal consensus procedure. After all, the integration of scientific evidence and clinical expertise determine the outcome of the assessments. Expert panels play an essential role in this procedure and are requested to study selected literature (derived from a structural search strategy) to integrate conclusions with their individual clinical expertise. In successive (online) rounds, experts scored the relevance of 21 selected risk factors on a 1-9 point-scale (not relevant-very relevant). In general, an indication is considered appropriate if the median score falls in the area 7-9 and inappropriate if the median falls in the area 1-3, and there is no major disagreement among panellists (29). Median scores were calculated and returned to all participants until consensus was reached. A final consensus meeting was scheduled for those topics where no consensus has been reached. The final results of this meeting were considered to represent 'the best integrated evidence' on the topic. The primary aim of this online consensus procedure was to select most relevant risk factors/indicators for each ROE patient (round I), resulting in a consensus-based set of relevant factor/indicators for both age groups. The selected risk factors/indicators were subsequently used for the composition of risk-based clinical vignettes (round II), eventually leading to a final expert consensus meeting (round III), (Figure 1).

Selection of expert groups

Sixty dentists were initially invited to participate in the online RAND Delphi procedure. The experts represented GDPs, dental researchers, dental educators, and dentists graduated in special fields (i.e. paediatrics, periodontology, gerodontology). Specific clinical and social characteristics (primary and permanent dentition, oral health compliance and growth and development) were the main reason to proceed with expert groups for two different age categories, i.e. children and adolescents (≤ 18 yr) and adults (> 18 yr). Experts were allocated to both panels by the research group, to accomplish appropriate strata of different age, expertise and place of residence of experts. A total of 31 experts participated, of whom 15 were allocated to age group '≤ 18 yr' and 16 to age group '> 18 yr'.

Figure 2. Screen dump, example of web page with clinical case risk factor identification schedule



Assessment of ROE patients

Experts were first invited to score for each ROE patient the impact of each individual risk factor/indicator on disease onset and progression. If a decision was made, a simple click on the button 'next factor' visualised the successive risk factor. In case additional specific clinical or non-clinical patient background information was needed to make appropriate decisions, experts could scroll a pop-up menu containing 'personal and patient data' (Figure 2). For each risk factor/indicator experts had to score the impact on a nine-point ordinal scale (1= not important - 9 very important). Finally, per ROE patient a recall interval had to be assigned. After completing all assessments, individual scores were collected. Subsequently, each expert was facilitated to evaluate the 'individual risk factor-score' and 'recall interval-score in months' to the median score of the group, so enabling to adjust their individual judgement.

Box 2. Consecutive oral health review steps determining the process of ROE risk management

I.	Retrospective analysis of previous risk level as documented in patient record
II.	Oral health assessment to identify risk factors/indicators and protective factors
III.	Assessment of the impact of risk factors on disease history and actual oral condition
IV.	Timing bitewing radiographs and preventive intervention(s)
V.	Classification of the actual risk level in patient record
VI.	Decision on patient-tailored recall interval

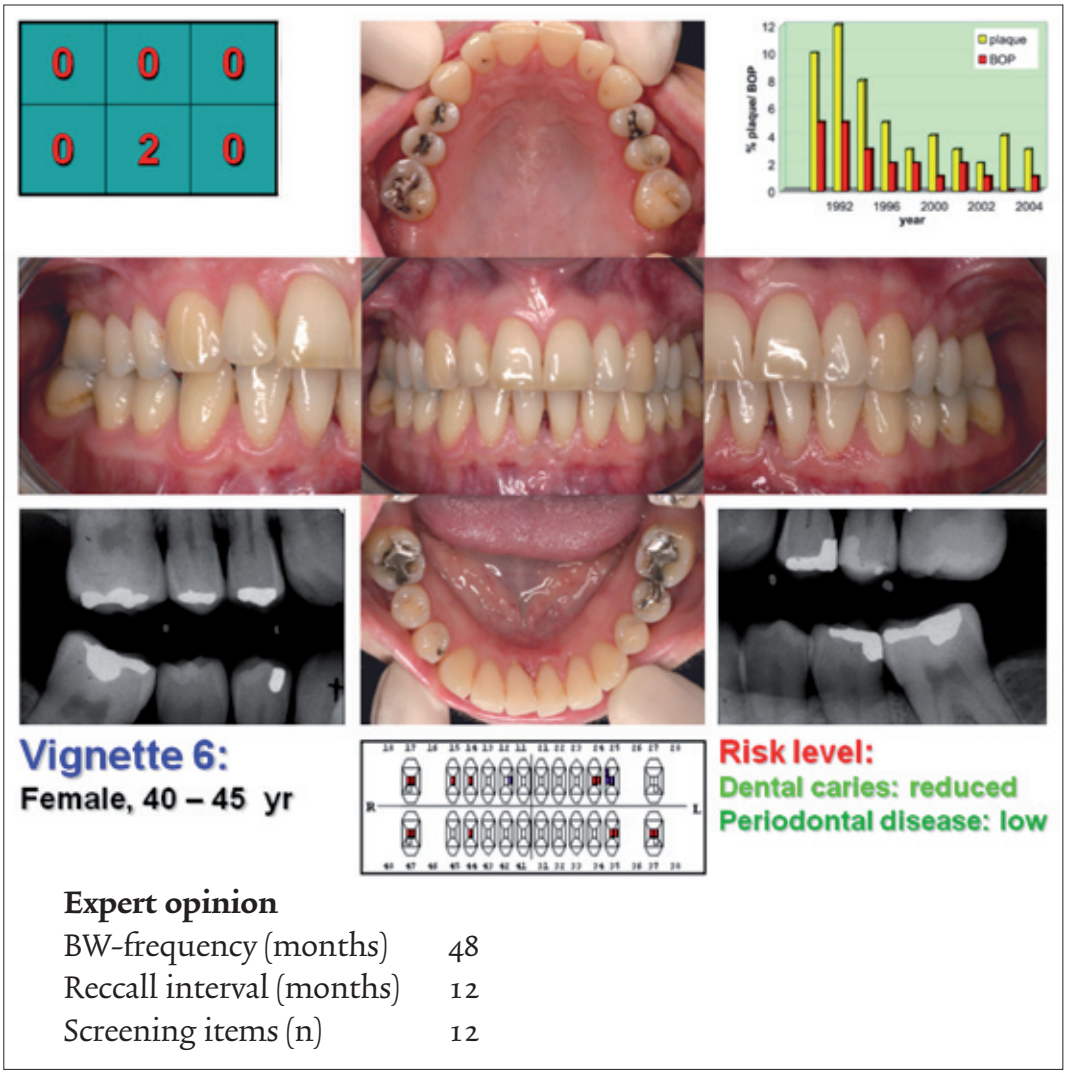
Assessment of patient vignettes

A patient vignette represents a specific patient age group, whose risk factors for oral disease as well as clinical and non-clinical patient characteristics are for the greater part similar. Per vignette, a risk profile is described with recommendations for the type and number of screening items to conduct, the frequency of bitewing radiographs and the assigned recall interval. Clinical and non-clinical characteristics comprised age category, patient history (medical, dental and social), attendance patterns, fluoride intake, dietary habits, extensive clinical information, and oral health compliance. Each vignette was presented in standardised oral cavity coloured pictures, additional radiographs, dental status chart, bar graphs on plaque and bleeding indices, periodontal graphs including the Dutch periodontal score index (DPSI)-graph (Figure 3). Experts were asked to classify the risk level (high, elevated, reduced, low) for dental caries and periodontal disease, an appropriate frequency for bitewing radiographs (in months) and the number of ROE screening items to perform. Finally, experts were asked to assign a preferred recall interval (in months), based on the rationale used for a risk management ROE strategy (Box 2).

Additionally, for each vignette examination items had to be selected out of a list of 19 ROE items. During these assessments, a direct hyperlinked to the summarised scientific literature was provided. In the 1st and 2nd round (Figure 1), both expert groups assessed on-line the provided patients and vignettes independently. ROE items scores, bitewing frequencies and recall intervals scores (in months) were tabulated per vignette with median scores and provided

for feedback before the final consensus meeting took place. Per expert group, ROE items selected by 9 or more experts (out of 15) were determined as applicable, if selected by 6-9 experts, they were scheduled for further discussion and if selected by less than 6 experts, the ROE items were excluded as not appropriate.

Figure 3. Screen dump example of risk-based clinical vignette applied in content management system



Expert consensus meeting

Finally, an expert group consensus meeting (5 hours) was planned for both groups separately in order to discuss the variation in judgement per clinical vignette. Both meetings were tape-recorded and observed by two research group members (TM, LvE) using a checklist (29).
A professional independent chairman (dentist) and a secretary were provided. The purpose was to reach final consensus for each vignette on content (relevant number of screening items), bitewing (BW) radiographs prescription frequencies and recall intervals. Each expert was invited

beforehand to answer online the four following questions:

(1) Are the patient's vignettes representing different risk levels of regular attending ROE patients?
(2) What is the most appropriate ROE content (type and number of items) per vignette? Which items are relevant and which are not? Is a specific sequence of ROE-items required?
(3) What is the most appropriate BW prescription frequency in months for each vignette?
(4) What is, for each vignette, the most appropriate recall interval? And which specific patient vignettes in adults are potentially appropriate for task delegation towards co-workers?

Two weeks before the consensus meeting took place, experts received the anonymously coded individual scores and median scores by mail as well as the description of the clinical vignettes as provided in the CMS. During the consensus meeting, full screen projection was available to facilitate adequately the mutual discussions. In addition, all experts were asked to fill out the total time (hrs) invested in the entire procedure.

Pilot experiment

A newsletter on the website of the Dutch Dental Association (NMT) invited peer groups to participate in the pilot, to test the online model for dental education purposes as well as for CPD. The NMT has so far a participation rate of 1650 out of 6230 GDPs, divided into 200 peer groups. A dental peer group consists of 7 - 9 GDPs, who attend monthly sessions scheduled for practice related topics as part of a quality assurance program. Members have to work in general dental practice for at least three days a week, and should have been practicing for at least five years. Five peer groups of GDPs from different regions in The Netherlands received beforehand online manuals and instructions how to use the CMS. When problems or questions occurred, feedback was provided. Eight of the nineteen patient vignettes were selected for assessment in the pilot, counting for the different risk levels and age groups (≤ 18 yr and > 18 yr). The expert opinions, including the recommendations regarding risk level, bitewing frequency and recall assignment per vignette were used as a reference standard and provided online immediate feedback when GDPs' opinion was divergent from the expert opinion.

Statistical analysis

Measurements of agreement in identifying risk factors were applied by means of group Kappa scores. To test differences in judgement between experts at the end of the consensus procedure for bitewing frequency and recall interval a two way ANOVA was performed with patient vignette and observer as independent variables. To test the influence of specific risk factors on the assigned recall interval, a one-way ANOVA was conducted. Regression analysis was used to evaluate the impact of individual risk factors on recall length. The level of significance was set at Alpha is 0.05. To determine variation between peer groups in the pilot, the assessments of five peer groups (35 GDPs) were subjected to ANOVA. Sign Rank tests were conducted to evaluate percentages of agreement with expert opinions concerning prescription of bitewing radiographs and recall intervals.

Results

Literature search

Two systematic reviews (2, 6) and one recent CPG (3) were identified concerning recall intervals and the context of ROEs. Based on the available search strategies and with additional searches for bitewing radiography prescription, eventually 146 studies were selected.

Risk factor assessment ROE patients

The degree of overall mutual agreement in identifying risk factors for both expert groups after round I was moderate to good (group Kappa ≤ 18 yr: 0.72; > 18 yr: 0.65). The variation between experts in assigning recall intervals (in months) was substantial, in high-risk ROE patients the standard deviation in recall interval was smaller compared to low-risk patients.
Finally, the age group '≤ 18 yr' was represented by eight vignettes covering the originally thirteen ROE patients, whereas eleven vignettes emerged from the originally fourteen ROE patients for age group '> 18 yr'.

Expert consensus meeting clinical vignettes

Out of the list of 21 risk factors/indicators, 10 factors were selected for modelling patient vignettes in age group '≤ 18 yr', whereas 16 risk factors were applicable for age group '> 18 yr' (Table 1). Consensus was reached concerning the content (number of screening items), bitewing frequency and recall interval per vignette. Both groups showed mutual agreement on specific ROE items to be performed in all patients and those that should be performed optionally (Table 2). The main oral health assessment domains 'patient history', 'clinical examination' and 'additional examination' were recommended to be carried out successively. Recurrent systematic recording of relevant clinical and non-clinical data was highlighted as an indispensable step in a patient-tailored risk strategy. From the 11 adult patient vignettes, 4 vignettes were determined to be feasible for ROE task delegation towards dental hygienists in general dental practice.

Representative set of patient vignettes

By conducting a stepwise risk-based management procedure, a comprehensive set of 19 patient vignettes emerged eventually for application in dental education and CPD. Both expert groups were unanimous in their concluding statement that the emerged set of clinical vignettes was representative for ROE patients in general dental practice, covering prevalent combinations of oral diseases.
In order to validate the model, an ANOVA-analysis of the influence of specific risk factors/indicators per vignette on recall length scores showed that certain risk factors were strongly 1 to 1 correlated, preventing reliable effects (confounding). Negative correlation coefficients were found both for specific risk factors versus bitewing prescription and recall intervals, suggesting that risk level and recall length were correlated.

Table 2. Numbers and type ROE screening items to perform as a result of RAND Delphi consensus procedure conducted with two expert groups for both age groups

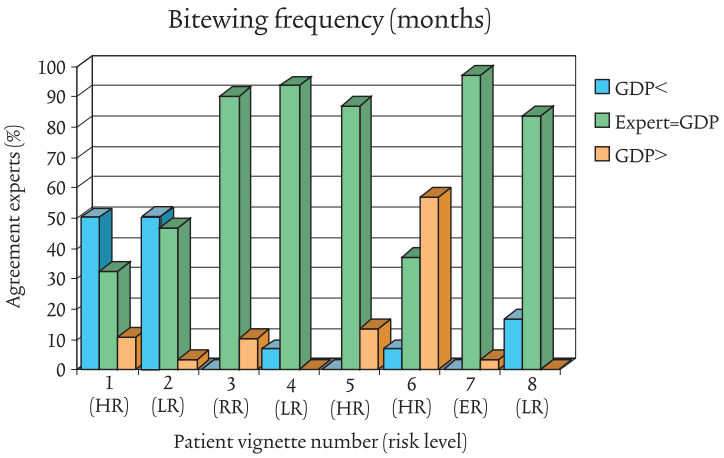
ROE-examination items	**≤ 18yr**	**> 18 yr**
Patient history		
Problems, complaints, discomfort*	☐	☐
Quality of life aspects (esthetical, functional)	☐	☐
Update patient history (medical, social, oral)	☐	☐
Update dental diagram	☐	☐
Analysis dietary habits**	☐	☐
Clinical examination		
Oral mucosa and oropharynx abnormalities	☐	☐
Oral health compliance (plaque and bleeding)	☐	☐
Detection and assessment dental caries	☐	☐
Screening periodontal disease	☐	☐
Restorations (past caries experience, quality)	☐	☐
Hard tissue wear (dental erosion, attrition)	☐	☐
Growth and development	☐	-
Patient communication and feed back	☐	☐
Periodontal pockets and attachment loss	☐	☐
Pathologic oral habits	☐	☐
Occlusion and articulation (functional abnormalities)	☐	☐
Screening third molar development	☐	☐
Saliva quality	☐	☐
Additional examination		
Dental radiographs	☐	☐

*: Bold typeface: items to perform standardised.
**: Normal type face: items to perform optional.

Time investment and follow-up

To conduct the entire RAND-modified Delphi procedure, dentists in expert groups '≤ 18 yr', and '> 18 yr' spend on average 5.9 hours (SD = 2.8) and 8.1 hours (SD = 3.6) respectively. From the 32 initial experts only three were lost for follow up.

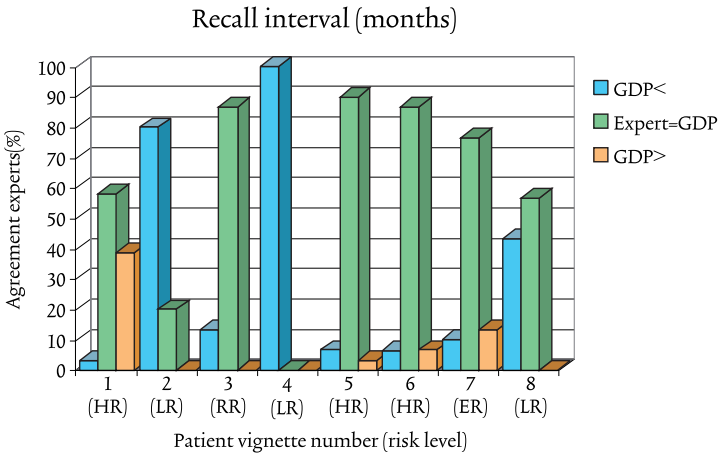
Figure 4. Percentages agreement for bitewing frequency prescription (in months) between experts and 35 GDPs in 8 patient vignettes for risk levels HR: high, ER: elevated, RR: reduced, LR: low



Pilot CMS

Five peer groups comprising 35 GDPs conducted the assessments of 8 selected patient vignettes. Variation in months within peer group scores concerning bitewing prescription frequency and recall interval was found to be very small. Bitewing prescription of GDPs showed overall more agreement with expert opinions compared to recall intervals. Significant differences ($p < 0.05$) in bitewing prescription (vignette 1, 6) were merely found in the high-risk patient vignettes showing lower frequencies compared to expert opinion (Figure 4). Concerning recall interval agreement, the most significant differences ($p < 0.05$) between GDPs- and expert opinions were found in the low-risk vignettes (vignette 2, 4, 8), (Figure 5) in which GDPs assigned considerably shorter intervals (in months) as compared to the expert judgement.

Figure 5. Percentages agreement for recall interval assignment (in months) between experts and 35 GDPs in 8 patient vignettes for risk levels HR: high, ER: elevated, RR: reduced, LR: low



Discussion

The main conclusion from this study is that risk-based patient vignettes regarding patient-tailored risk management of ROEs, developed by means of a validated online consensus procedure, provide a promising educational instrument for CPD. As shown in the pilot experiment, experienced GDPs, using the online system, are performing in accordance with expert opinions, except for both ROE aspects most in need for improvement in a patient-tailored risk strategy, i.e. the low-risk patient vignettes concerning recall interval and the high-risk patients concerning the bitewing frequency. It is assumed that when the CMS is useful for CPD, it can also play a significant role in undergraduate computer-assisted learning and training in Dental Schools.

Overall, the process to develop good quality clinical patient vignettes regarding the content and frequency of ROEs is a rather time consuming (for both 'developers' and participating experts) and expensive procedure, nevertheless also innovative as a stepwise teaching tool to improve clinical decision-making for both undergraduates and GDPs. As far as we know, risk-based patient vignettes are seldom used in dental education to guide patient risk management problems, despite earlier research on patient management problems and problem solving some decades ago (35). Patient vignettes, applied in a peer group educational setting and provided with interactive feedback on individual as well as group performances, may be potentially effective for implementation strategies to improve clinical performance in daily practice.

This set of 19 clinical vignettes provides a representative set of prevalent combinations of oral disease in the Netherlands and might therefore be applicable in more industrialised Western countries with a low prevalence of oral disease. Due to this specific procedure carried out, these set of vignettes could be used to start a structured development procedure of a national ROE clinical practice guideline (CPG). After all, the literature has already been systematically searched and appraised and the most important national clinical and research experts committed themselves to the results, so two elementary steps of structured CPG development are fulfilled (36, 37). Furthermore, this constructed online model could be also easily transformed into an educational instrument applicable in other countries with divergent prevalence's of oral disease and attendance patterns.

Advantages of working with online assessments are the less time-consuming activities for individual patients and dentists compared to assessments of selected standardised patients in a dental clinic, the improving technical possibilities of electronically databases, the 'relative' freedom of going online, the immediate provision of feedback individually as well as to groups of peers, and last but not least the efficient data collection by teachers and researchers with appropriate software for educational and research purposes. Nevertheless, a substantial disadvantage of the CMS is the lack of real life interaction between patient and professional, making the assessment in a particular way 'artificial'. This could probably be overcome by active involvement and prudent nationwide selection of experts of different dental fields to prevent underexposure of relevant clinical characteristics in specific ROE patients.

Four out of the eleven vignettes were determined by experts to be feasible for ROE task

delegation towards co-workers (dental hygienist) within dental teams. This enables members of dental team to assess and discuss risk management strategies and improve clinical performance of ROEs in general dental practice.

Recent literature suggests that a 6-monthly recall assignment is still the preferred standard for both patients and dentists (10, 38). After all, risk-based ROE refers to a stepwise process in which certain activities (patient history update, risk assessment, and recording data) are a prerequisite for patient-tailored recall interval assignment. The individual assessment scores provided by the experts could be biased due to the fact that the experts were not used to assess and count for all the steps in a risk management process. After all, little is known how dentists are conducting risk assessment concerning ROEs in daily practice. Well known are the extensive inter-practitioner variation in clinical decision-making (11-15), especially in the context of the complex multifactorial aetiology of oral diseases. In view of the mean age of selected experts, our assumption was that experts were not all familiar with systematic risk management. Therefore, some guidance in developing vignettes was our primary goal, based on described stepwise risk management. We started the assessments in the CMS with identifying the main set of risk factors/indicators tailored to recall intervals of 27 different ROE patients. This approach resulted in structured discussions, about which type of risk factors/indicators were most relevant for specific ROE patients, eventually resulting into expert consensus about different sets of factors for both age groups.

One of the pitfalls experienced by the research group concerned the huge amount of patient data to select for, and provide in each selected ROE patient. As a consequence, experts got easily into extensive discussions on less relevant details and items, distracting them from an overall risk assessment strategy. Therefore, we synthesized the most relevant patient data focussed on risk management for stepwise assessments in each patient vignette. For that reason, there might have been some guidance from the research group.

We intended to validate the model but failed to do so due to the extensive number of variables within each vignette and the strong correlation (one to one confounding) between specific relevant risk factors. The total number of assessments made by both expert groups was too small to be reliable for statistical analysis and prevented a straightforward regression analysis with applied risk factors as dependent and assigned recall periods as independent variables. Only strong correlation coefficients (negative) emerged between specific risk factors and the assigned recall periods. Therefore a pilot experiment was conducted to further analyse the use of the model by experienced GDPs. Further long-term studies are needed to deliver more data on the reliability of this set of patient vignettes.

For undergraduate dental education as well as for clinical practice, risk-based patient vignettes could be used as an educational instrument to train dentists in selecting high- and low-risk patients, and improve decision-making. Used in peer group assessment with educational feedback as a consequence, this model could be used as an implementation instrument to change routine performance in daily practice i.e. to implement a CPG.

Furthermore, patient vignettes can also serve as a tool for measuring quality of clinical practice

(20) compared to (standardised) real life patients and chart abstraction (21). Applied in a scientific context, an additional validation experiment should be carried out in what way (reliability) this set of vignettes measures risk-based oral screening and improves quality of oral care. For measuring the quality of the decision-making process, specific software build into the database could reveal data on the total numbers of clinical and non-clinical items from which individual participants retrieve information to underpin their decisions. Further experiments how to optimize the CMS and how users step by step are dealing with the information provided in the CMS is needed.

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Chapter 9

A cluster randomised controlled trial in primary dental care based intervention to improve professional performance on routine oral examinations and the management of asymptomatic impacted third molars: study protocol

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Implementation Science 2007; 2: 12

Abstract

Introduction

Routine oral examination (ROE) refers to periodic monitoring of the general and oral health status of patients. In most developed Western countries a decreasing prevalence of oral diseases underpins the need for a more individualised approach in assigning individualised recall intervals for regular attendees instead of systematic fixed intervals. From a quality of care perspective, the effectiveness of the widespread prophylactic removal of mandibular impacted asymptomatic third molars (MIM) in adolescents and adults is also questionable. Data on the effectiveness of appropriate interventions to tackle such problems, and for promoting continuing professional development in oral health care are rare.

Methods/Design

This study is a cluster-randomised controlled trial with groups of GDPs as the unit of randomisation. The aim is to determine the effectiveness and efficiency of small group quality improvement on professional decision-making of general dental practitioners (GDPs) in daily practice. Six peer groups ('IQual-groups') shall be randomised either to the intervention arm I or arm II. Groups of GDPs allocated to either of these arms act as each other's control group. An IQual peer group consists of eight to ten GDPs who meet in monthly structured sessions scheduled for discussion on practice-related topics. GDPs in both trial arms receive recently developed evidence-based clinical practice guidelines (CPG) on ROE or MIM. The implementation strategy consists of one interactive IQual group meeting of two to three hours. In addition, both groups of GDPs receive feedback on personal and group characteristics, and are invited to make use of web-based patient risk vignettes for further individual training on risk assessment policy. Reminders (flow charts) will be sent by mail several weeks after the meeting.

Outcome measures

The main outcome measure for the ROE intervention arm is the use and appropriateness of individualised risk assessment in assigning recall intervals, and for the MIM intervention group the use and appropriateness of individualised mandibular impacted third molar risk management. Both groups act as each other's control. Pre-intervention data will be collected in study months one through three. Post-intervention data collection will be performed after nine months.

Key words

Cluster-randomised trial, routine oral examination, third molars, implementation research, clinical practice guideline.

Background

Routine oral examination (ROE) refers to periodic monitoring of the general and oral health status of patients. The main purpose of ROEs is to prevent the onset of oral diseases and/or prevent further progression. This allows the introduction of preventive interventions at the appropriate time, and reduces the need for operative interventions. In most developed Western countries, a decreasing prevalence of oral diseases underpins the need for a more individualised approach in assigning individualised recall intervals for regular attendees instead of systematic decision-making of fixed intervals. In The Netherlands, about 80% of the population regularly visits the dentist for a check-up about every six months (1). This implies that many healthy individuals are scheduled for routine oral screening. In 2000, 50% of the Dutch GDPs assigned all their regular patients for ROE twice a year (2), irrespective of level of risk for oral disease. The efficiency of this systematic monitoring system is still disputed in The Netherlands, as well as internationally (3-10). Recently, two systematic reviews (11, 12) and a clinical practice guideline (CPG) advocated an individualised risk-based assessment strategy, given the lack of good scientific evidence (13). In addition to the debate over the frequency of ROE, one can question, from a quality-of-care perspective, the effectiveness of the widespread prophylactic removal of mandibular impacted asymptomatic third molars (MIM) in adolescents and adults (14-16).

Recent implementation studies in medical care indicate that evidence on the effect of single interventions is mixed (17, 18). It is as yet unclear how quality of oral care in dental practice can be improved. Research data on effectiveness of interventions to promote continuing professional development for dentists are rare (19). A previous study showed that small group education sessions did not change dentists' clinical behaviour (20). The aim of the present study is to evaluate whether a multifaceted strategy can enhance oral health care according to evidence-based dental practice. Consensus-based CPGs on ROEs (13) and on the management of MIMs (20) are available for educational purposes in clinical practice.

Aim of the study

To determine the effectiveness and efficiency of small group quality improvement on professional decision-making of general dental practitioners (GDPs) concerning risk assessment in ROEs (including assigned recall intervals) and risk management of MIMs for patients (children and adults) in dental practice.

Scientific hypothesis

Multifaceted implementation of consensus-based clinical practice guidelines (CPGs) for GDPs on ROEs and the management of MIMs in daily dental practice are more effective and efficient compared to dissemination of CPGs only.

Methods

Study Design

The study is a cluster-randomised trial with incomplete block design. In one trial arm, the intervention focuses on individual decision-making in scheduling ROEs. In the second arm, the

intervention focuses on monitoring and decision-making regarding prophylactic removal versus retention of MIM (Figure 1). Groups of GDPs allocated to either of these arms act as each other's control group. To reduce potential contamination, groups of GDPs are randomised rather than individual GDPs (Table 1). We assumed that the two clinical conditions (or practices) were largely independent of one another, i.e. performing one would not necessarily influence the other. In the ROE arm, the CPG only mentions the necessity of third molars screening in general as routine oral care. In the MIM arm, the CPG provides an extensive, but specific, decision-making algorithm, i.e. how to deal with mandibular asymptomatic impacted third molars.

Figure 1. Design timeframe implementation study concerning CPGs on ROE and MIM

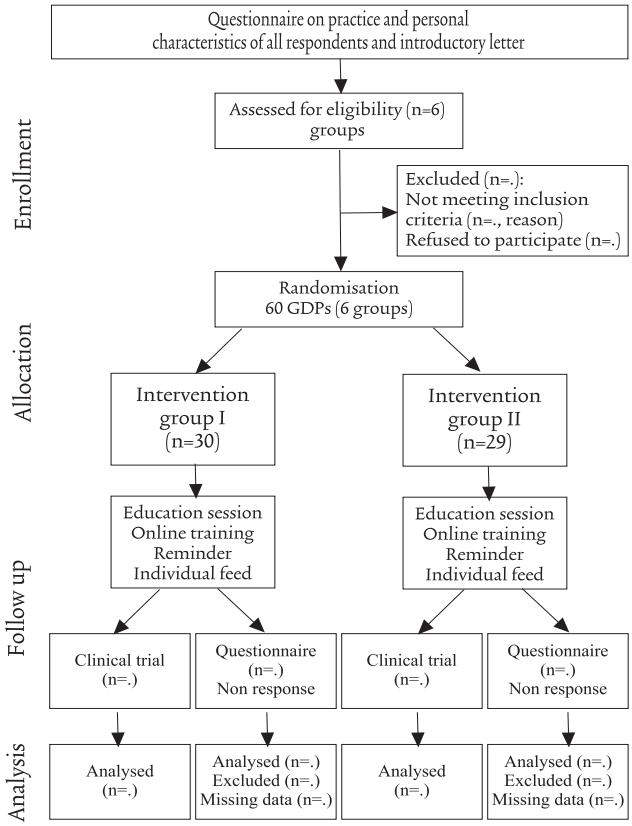


Table 1. Balanced incomplete block design

Intervention	**CPG**	
	ROE	**MIM**
Group I (ROE)	Intervention	Control
Group II (MIM)	Control	Intervention

Intervention: Clinical Practice Guideline (CPG) on the management of routine oral examinations (ROE) and asymptomatic mandibular impacted third molars (MIM).

Recruitment of GDPs and inclusion/exclusion criteria

Dental peer groups ('IQual group'), each comprising at least eight participating GDPs, are the unit of randomisation. An IQual group consists of GDPs who attend monthly sessions scheduled for discussion on practice-related topics as part of a quality assurance program. Participants in peer groups generally support quality-improvement procedures, and are experienced in continuing dental education and professional cooperation. The Dutch Dental Association (NMT) has initiated this system, and supports nationwide dental peer groups extensively, e.g., offering professional support, feedback and continuing education programmes. All IQual groups were invited to participate in this study by a general announcement on the NMT website, dependent on their ability to begin the study within two to three months. Those groups that were interested in participating were invited to visit a section of the NMT website (http://www.NMT.nl) for members only that provided more detailed information on the project.

GDP inclusion criteria

The inclusion criteria consisted of:

(1) GDPs who work for at least for three days a week in general dental practice for a minimum of three years.
(2) GDPs who have a patient population of regular ROE attendees and manage their patient records electronically.
(3) GDPs were required to give their informed consent for the assessment and evaluation of electronic patient records. Patient data are collected anonymously.

Patient's inclusion criteria

To be eligible for inclusion in the study, all patients must have regularly visited the same dentist at least once a year for ROEs over the preceding three years. For the MIM arm, patients should also be between 17 and 35 years of age, and with disease-free impacted mandibular third molars in retention.

Patient's exclusion criteria

For the ROE arm, patients with symptomatic-driven (emergency) attendance in dental practice, or regular attendance in the participating dental practice of less than three years, are excluded from the study. For the MIM arm, patients with symptomatic or previously removed third molars, or regular attendance in the participating dental practice of less than three years, are excluded from the study.

Intervention

Implementation strategy

Participants in both trial arms receive a recently developed evidence-based CPG on ROE or MIM. The implementation strategy consists of one interactive IQual group meeting of approximately two to three hours with a minimum of eight GDPs each. These meetings discuss the

selected intervention topic, and offer a more risk-based decision-making process guided by the CPG. Topics regarding risk management, such as identification of risk factors/indicators, preventive interventions, prognosis, monitoring, record keeping, and patient scheduling are presented. In addition, all participants receive feedback from personal and group characteristics retrieved from pre-test questionnaire and specific record forms, and are invited to make use of web-based patient risk vignettes for further individual training on risk assessment policy. These risk vignettes were developed by structured consensus procedures (RAND-modified Delphi) with expert groups consisted of acknowledged GDPs and oral surgeons in special fields. In addition, reminders (flow charts) and written patient leaflets with topical information are provided during the trial period. Flow charts comprise algorithms of decision-making aspects linked to the trial arm allocation. Depending on the allocated trial arm, participants are subjected to a set of planned interventions as described in Table 2.

Table 2. Overview of planned interventions in groups I and II

	Interventions for all IQual groups	
Composition IQual group Introductory letter (individual) Delivery registration forms and questionnaires	Questionnaire GDPs 25 registrations chair side	
	Randomisation	
Interventions trial arms	**ROE group I**	**MIM group II**
Delivery CPG on ROE versus MIM by post	CPG ROE	CPG MIM
Education session IQual group	ROE education	MIM education
Online training website (individual feedback)	Access to ROE-based training	Access to MIM-based training
Reminder (flow chart), individual feedback record form Feedback by email	ROE aspects, Flow chart	MIM-aspects, Flow chart
Registration in practice (25)	25 registrations in practice chair side	25 registrations in practice chair side
End trial	Questionnaire	Questionnaire

Randomisation

After their commitment to participate, 60 GDPs nested in six IQual groups were randomly assigned (using SPSS) as groups to the ROE or MIM arm by an independent secretary not familiar with the groups. The unit of randomisation was the IQual group.

Table 3: Outcome parameters and instruments

Outcome parameter		Instruments
Primary ROE outcomes	▸ Clinical Performance/decision-making: Number of patients per GDP with assigned recall interval (months) based on individual risk profile assessment. For high-risk children and adolescents' less or equal than 7 months, in case of low-risk profile more than 7 months. For high-risk adults' profiles, less than 9 months and, for low-risk adults' profiles, 9 months equal or more.	Patient record, registration form risk management
Secondary ROE outcomes	▸ Clinical Performance/decision-making: Number of patients per GDP with prescribed individual frequency of BWs (months). For high-risk children and adolescents prescription frequencies of less than 24 months, and for low-risk profiles, frequencies of equal or more than 36 months; for high-risk adults, frequencies less than 36 months, and for low-risk adults, frequencies more or equal than 48 months. ▸ Number of patients per GDP with periodontal DPSI-score > 1, and prevalent caries, whom has been given feedback, information and preventive advice, registered in patient record or registration form. ▸ Efficacy data/cost-effectiveness scores: Mean overall length in months of recall intervals per GDP over the past 3 yrs. Mean total number of BW(s) and other radiographs over past 3 years. Type of performer GDP/Oral hygienist/others (level of graduation - education). Total number of additional interventions performed during ROE (polishing, removal of calculus: coded as M50, M55). ▸ Professional attitudes and compliance: Measured at the start and at the end by questionnaire	Patient record, registration form, Questionnaire to analyse additional performance and cost-analysis
Primary MIM outcome	▸ Clinical performance / decision-making: Number of patients (between 18 –30 yr of age) with removed versus retained MIMs in accordance with CPG, or with indication for removal Number of risk based assessment radiographs between 17- 35-yrs/per patient with risk based for assessment of prognosis MIM.	Patient record, registration form risk management
Secondary MIM outcome	▸ Professional attitudes/feedback: Interviews of patients (17-35 years of age) to confirm risk based performance.	Questionnaire

Outcomes and instruments

ROE study

Table 3 lists the outcome parameters and instruments used.

For the ROE arm, the primary outcome measure is:

- The use and appropriateness of individualised risk assessment measured through the assigned recall intervals (in months). The appropriateness will be assessed as follows: For high-risk children and adolescents (≤ 18 years), recall intervals of less or equal than 7 months should be assigned. For those with a low-risk profile, an assigned recall of more than 7 months is considered appropriate. For high-risk adults (> 18 years): recall intervals of less than 9 months should be assigned. For those with a low-risk profile, an interval of 9 months or longer is considered appropriate.

The secondary outcome measures for the ROE arm are:

- The use and appropriateness of individualised risk-based assessment in prescribing bitewing radiographs (BWs) in months. The appropriateness will be assessed as follows: For high caries-risk children and adolescents (≤ 18 years): BW frequencies of less than 24 months are determined as appropriate; for those with a low-caries risk profile, BW frequencies ≥ 36 months. For high caries-risk adults (> 18 years): BW frequencies less than 36 months are determined as appropriate; for those with a low-caries risk profile, BW frequencies of ≥ 48 months.
- The use and appropriateness of individualised communication/feedback and advice in patients with a periodontal risk DPSI-score > 1, and present dental caries experience. The appropriateness will be assessed as the proportion of patients per GDP receiving appropriate preventive advice/feedback will be calculated. Furthermore, as a secondary outcome measure, professional role perceptions and compliance concerning the recommendations of the ROE-CPG is assessed by means of questionnaires provided at the beginning and end of the study.
- Resource use will be documented for an economic evaluation: The type of recall interval (months) per GDP over the past 3 years
  BW radiographs and other types of radiographs per GDP over the past 3 years
  Type of performer of ROEs: GDP versus oral hygienist/dental auxiliary
  Additional interventions per GDP (i.e. polishing stains/removing dental calculus) encompassed at ROEs over the past 3 years.

MIM study

For the MIM arm, the primary outcome is:

- The use and appropriateness of individualised MIM risk management. The appropriateness will be assessed as follows: Patients (17-35 years of age) with removed versus retained MIMs over the past five years as a proportion of patients aged between 17-35 years of age per practice. Radiographs used for monitoring patients mentioned above to perform a risk-based assessment and prognosis of MIM over the past five years.

A secondary outcome measure is:

- GDPs- attitudes and compliance concerning the recommendations of the MIM-CPG, and relating that information to patients. This measure will use data from patient interviews to confirm risk-based performance.

All data will be collected using special registration forms to be completed by GDPs and patient records available in practices. Questionnaires, patients' records, and registration forms will provide information to assess all outcome parameters. The structured registration forms were used in a previous self-recording study (21).

Data collection

After their informed consent to participate, GDPs will be invited to first complete a questionnaire to collect personal and practice characteristics, as well as aspects of attitude and compliance. Individual assessment of electronic patient records with regard to the outcome measures, combined with a special registration form (to be applied individually in daily practice), will be used during the evaluation period.

Baseline information will be collected before randomisation of groups, as well as at the end of the trial after seven to nine months. Each GDP will be instructed to complete at least 20 forms per registration period. As each peer group consists of at least eight participants, and each arm will consist of three groups, this will result in a minimum of 480 registrations per trial arm. Finally, questionnaires will be collected from GDPs, dentist's assistants and co-workers to assess acceptance and applicability.

Sample size

The primary outcome measures in this study are collected from individual patients who are clustered within GDPs. GDPs are clustered within (existing) IQual groups which have been randomised to one of the two arms of the trial. The power calculation assumes that the primary outcomes are dichotomous measures, although some outcomes might be treated as continuous measures as well. On the basis of previous research and experience with IQual groups, we expect a relatively high clustering of scores within GDPs, for instance, the intra-cluster coefficient (ICC) for recall interval assignment was 0.29 (21), and a low clustering of scores within IQual groups (changing professional behaviour is largely determined by other factors). We use the ICC for clustering in IQual groups, because this was the unit of randomisation. We aim for a 20% change on primary outcomes (e.g. 20 to 40% patients receive individualised recall intervals). Assuming a power of 80%, alpha = 0.05 and an effect size of 20% for both interventions and an estimated ICC of 0.03 based on previous estimates (22, 23), the (Aberdeen) power calculation (24) revealed that six IQual groups (60 GDPs) should comprise 150 registrations (patients) per group, resulting in at least 450 registrations in each trial arm.

Statistical analysis

The primary analysis will be performed on an intention-to-treat-analysis. Secondly, measures will be constructed in particular algorithms to define the appropriateness in variables. Thirdly, the

impact on each of the primary and secondary outcomes will be estimated separately, using random effects regression models (linear or logistic) to take into account the clustering of data. These basic models include group allocation (intervention, control), measurement timing (baseline, post-intervention), and interaction of group allocation and measurement timing (= intervention effect). Fourthly, prognostic factors for the outcome (which may be confounders) will be added to the models, like patients' recall interval preferences, which varies from those assigned by GDPs, as well as the preferences regarding the prescription of radiographs by patients/GDPs. In addition, this also accounts for GDPs and patients' preferences regarding removal versus retention of asymptomatic impacted third molars. Fifthly, a limited number of subgroup analyses will be performed, including an analysis of effectiveness in participants which performed all activities as planned, i.e., education session, online training program, and helpdesk (= efficacy analysis).

Economic evaluation

An economic evaluation is performed to estimate the cost-effectiveness of the implementation intervention. This study takes a healthcare perspective and a time horizon that is similar to the implementation trial.

Effectiveness

The effects are defined in terms of professional performance, because measuring health outcomes or health utilities is beyond the scope of the study. Outcome measures will be the same as in the trial (e.g. oral health risks assessment performance and guideline adherence regarding individual recall assignment and individual monitoring of impacted asymptomatic third molars) and extracted from the trial data.

Costs

Costs considered are those used for the implementation (time for participation by GDPs, preparation time, use of materials) and for changes (if any) in professional performance (recall intervals between successive ROEs, total number of radiographs, both based on individual risk assessment). Oral care unrelated to the topic of the interventions within the observed time period will not be considered. Resource use will be extracted from trial data, where possible, or collected separately for the purpose of the economic evaluation. Costs will be valued according to prevailing Dutch guidelines for economic evaluations, and alternatively according to the current national fee-coding list for individual oral treatment procedures in general dental practice.

Analysis

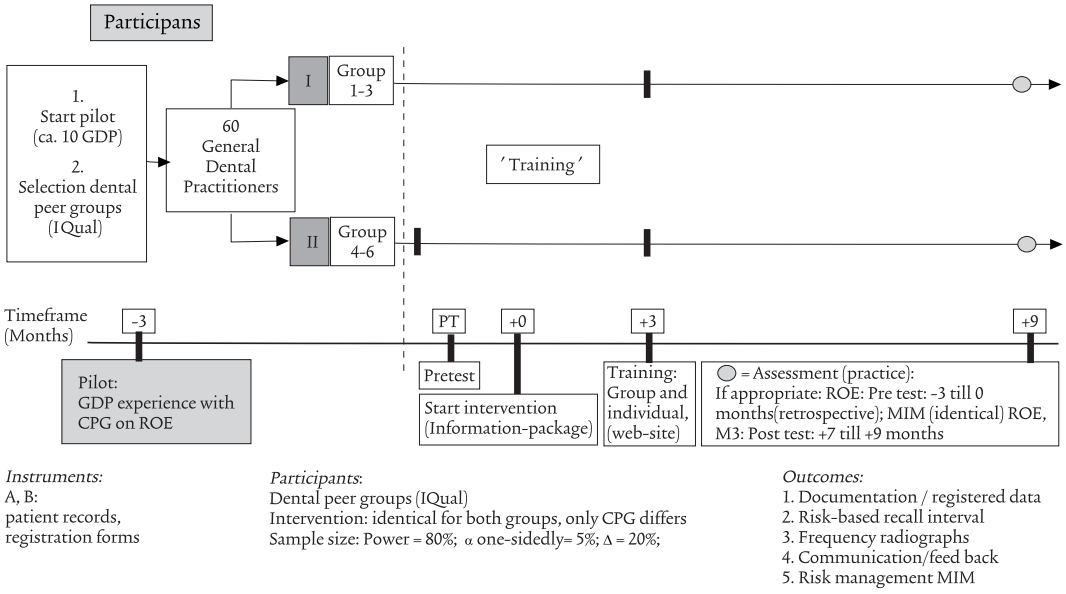
An incremental cost-effectiveness ratio (ICER) will be constructed that expresses the ratio of differences of costs and effects between the study arms (for each of the two clinical topics). Uncertainty will first be examined in one-way sensitivity analyses of the most influential factors. Finally, a non-parametric bootstrap re-sampling analysis will be performed, which provides a cost-effectiveness plane for a simulated sample of 1,000 drawings (with put-back) from the pool of observed cost-effect pairs.

These data will be compiled from questionnaires, patient risk profiles, registration forms, and from electronic patient records. All instruments were pre-tested in a pilot study. Measurements and analysis of pre-test data will be performed before or during the intervention period (for retrospective data sampling), and after the intervention period (post-intervention data).

Timeframe of the study

We plan to randomise six of the initially recruited IQual groups that have declared their willingness to participate in this study, and to assign them randomly to one of the two intervention arms. The baseline data collection will take place at the beginning of the study during months one and two. The intervention will start in months two and three and follow-up data collection will be collected in months eight through ten. The scheduled time for the trial is estimated to be seven to ten months (Appendix 1), assuming that each GDP will collect data from at least 20 regular attending patients by means of the trial registration form.

Appendix 1. Flow diagram of different steps with timeframe



Instruments:
A, B:
patient records,
registration forms

Participants:
Dental peer groups (IQual)
Intervention: identical for both groups, only CPG differs
Sample size: Power = 80%; α one-sidedly= 5%; Δ = 20%;

Outcomes:
1. Documentation / registered data
2. Risk-based recall interval
3. Frequency radiographs
4. Communication/feed back
5. Risk management MIM

Discussion

Little evidence was available on the estimates of the likely size of dental primary care ICCs, and which prognostic factors influenced their magnitude. Based on research in this field, we assumed a substantial variation in primary dental care between fairly autonomous GDPs (25-28). Data extracted from primary health care suggested that ICCs for patient outcomes in primary care were generally less than 0.05 (22, 23). In reviews of this protocol, questions were raised about the power calculation. In particular, the expected effect size was seen as large, and the applied ICC as low. This would imply that the power calculation is too optimistic, and that the study might be underpowered to detect meaningful change in professional behaviour.

Ethical and legal aspects

The study protocol was approved by the Ethics Committee of the Radboud University Nijmegen Medical Centre, prior to the start of the study in September 2006 (approval number CMO nr. 2006/168). All patient data and other confidential information fall under dental confidentially rules, and are stored on a protected server of the Radboud University Nijmegen Medical Centre. Only members of the study team have access to the files.

Authors' contribution

All authors declare that they have no competing interests. TM, WvdS and MW performed the study and drafted the manuscript. AP and RG participated in the study design. All authors have read and approved the final manuscript.

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Chapter 10

Impact of multifaceted peer group education to improve routine oral examinations in primary care
A cluster-randomised controlled trial

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Submitted

Abstract

Background

In most developed Western countries a decreasing prevalence of oral diseases underpins the need for a more individualised approach in assigning recall intervals for regular attendees instead of systematic fixed intervals.

Methods

This study was a cluster randomised controlled trial with groups of general dental practitioners (GDPs) as the unit of randomisation. The aim was to determine the effectiveness of multifaceted peer group education on decision-making of GDPs in daily practice. Patients who visited dental practice for routine oral examination (ROE) were prospectively enrolled in the trial. Patient data were collected using case registration forms to be completed by GDPs and patient records. Seven peer groups of GDPs were randomised either to the intervention arm or control arm. GDPs in both trial arms received actual evidence-based clinical practice guidelines (CPG) focussed on the subject of the allocated trial arm. Primary outcome (recall assignment) and secondary outcome measures (bitewing radiograph-frequency) were defined. The interventions comprised successively online training using risk-based patient vignettes, dissemination of a CPG by mail, and an interactive peer group meeting for continuing professional development (CPD) with group feedback. Reminders (flow charts) were sent by mail four weeks after the meeting. GDPs were given access to online vignettes for further individual training.

Results

Recall assignment: The rate of guideline adherence in high-risk patients showed a small increase in the control group (+2.7%) and a decrease in the intervention group (-0.8%), a difference that was not significant ($p = 0.18$). For low-risk patients, guideline adherence increased in the intervention group with +8%, which differed significantly from the control group (-6.1%), ($p = 0.00$).
Bitewing frequency: The rate of guideline adherence in high-risk patients in the intervention group hardly changed (-1.3%), while in the control group guideline adherence improved substantially (+24.1%), ($p = 0.02$). In low-risk patients the intervention group slightly changed performance (-1.3%), while in the control group a substantial decline in adherence (-17.5%), ($p < .0001$) was found.

Conclusions

The results of this trial showed small to moderate effects in primary outcome measures in low-risk patients. Concerning the secondary outcome measure conflicting results were found both in low-risk and high-risk patients. Further research into barriers for performance change in dental practice is recommended.

Key words:

Cluster-randomised trial, routine oral examination, implementation research, practice-based research, clinical practice guideline.

Introduction

Routine oral examination (ROE) refers to periodic monitoring of the general and oral health status of patients. The main purpose of ROEs is to prevent the onset of oral diseases and/or prevent further progression. This allows the introduction of preventive interventions at the appropriate time, and reduces the need for operative interventions (1). In most developed Western countries, a decreasing prevalence of oral diseases (2–5) underpins the need for a patient-tailored approach in assigning individualised recall intervals for regular attendees. In The Netherlands, like in many other countries, about 80% of the population regularly visits the dentist for a check-up every six months (6). This implies that many individuals with good oral health are scheduled for ROEs.
In a prospective recording study, it was found that 70% of Dutch GDPs assigned all their regular attendees for ROE twice a year (7), irrespective of the risk level for oral disease. The effectiveness and efficiency of such a systematic monitoring system is disputed internationally (8–18). Other research showed that many patients in health care do not receive appropriate care (19), receive unnecessary (20, 21) or even harmful oral care (22). Evidence based practice aims at the best treatment option available for individual patients based on solid research and clinical information (23), even when practitioners are informed about research evidence that does not necessarily result in changing daily practice routines (24). Experts on implementation in medical care suggested that interventions should be tailored to the performance aspects that are most in need of improvement (25, 26). A substantial body of implementation literature regarding effects of different strategies in medical practice suggest multifaceted implementation strategies (27–33).
It is as yet unclear how quality of ROEs in dental practice can be improved. Research data on effectiveness of interventions to promote continuing professional development for dentists are rare (34). A previous study showed that small group education sessions did not change dentists' clinical behaviour (35). To investigate the effectiveness of a rigorously developed implementation program, we performed a cluster-randomised controlled trial in 51 general dental practices. The aim of the present trial was to determine the impact of a multifaceted implementation strategy with a variety of methods on recall assignment in general dental practice.

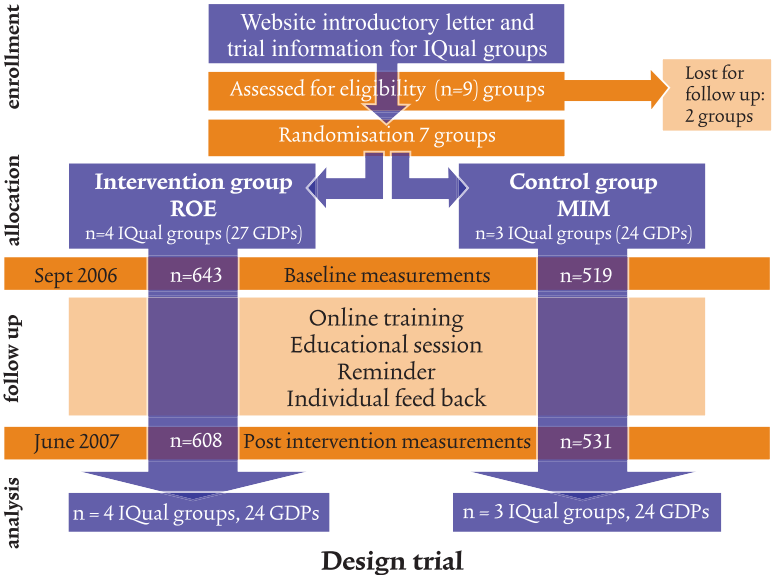
Patients and Methods

Study Design

The study performed was a cluster-randomised trial with incomplete block design, which implies that the two arms of the study served as each other controls. In the intervention arm, the implementation focused on individual decision-making in scheduling ROEs. In the control arm, the implementation focused on monitoring and decision-making regarding prophylactic removal versus retention of asymptomatic mandibular impacted molars (MIM), (Figure 1). To reduce potential contamination, peer groups of collaborating GDPs were randomised rather than individual GDPs. For detailed information on cluster trial design and power calculation, we refer to the free online publication of the study protocol (36). The study protocol was approved by the Ethics Committee of the Radboud University Nijmegen Medical Centre, previous to the start of the study in September 2006 (approval number CMO nr. 2006/168). The trial was registered with

ClinicalTrials.gov (identifier, NCT00618215). All patient data and other confidential information fall under dental confidentially rules and are stored on a protected server of the Radboud University Nijmegen Medical Centre. Only members of the study team have access to the files.

Figure 1. Design of the trial arm with intervention routine oral examination (ROE) and control group mandibular impacted molars (MIM)



Design trial

Patients

GDPs prospectively enrolled patients who visited dental practice for a ROE during September 2006 - October 2006 (baseline) and from May – June 2007 (follow up). To be eligible for inclusion in the study, patients had to have visited the same dentist regularly at least once a year for ROEs over the preceding three years. Patients with symptomatic-driven (emergency) attendance in dental practice, or regular attendance in the participating dental practice since less than three years, were excluded from the study.

GDPs in peer groups

Dental peer groups ('IQual-group'), each comprising generally of eight participating GDPs, were the unit of randomisation. An IQual group consists of GDPs who attend monthly sessions scheduled for structured discussion on practice-related topics as part of a quality assurance program of the Dutch Dental Association. The inclusion criteria for GDPs were: at least working for three days a week in general dental practice for at least three years, a patient population of regular attendees, electronically documented patient records and willing to give informed consent for the assessment and evaluation of electronic patient records. Patient data were collected anonymously. After their commitment to participate, 51 GDPs nested in seven IQual peer groups were randomly assigned, using a computer generated list of random numbers to the intervention or control arm by an independent secretary not familiar with the groups.

Outcome measures

The primary outcome measure, collected for each patient, was guideline adherent recall interval assignment (in months) and the secondary outcome measure, collected for each patient, was guideline adherent bitewing radiograph frequency prescription (in months). A decision was determined to be CPG adherent when the recall period or bitewing frequency in months was assigned individually tailored to the assessed and recorded risk for oral disease on the case-registration form. CPG overall adherence was reported for all patients as well as for the planned low- and high-risk subgroups separately.
Primary patient outcome measures collected for recall interval decision-making:
Considered to be CPG adherent in the children and adolescent group were patients with a high-risk profile being assigned a recall interval ≤ 7 months as well as patients with low-risk profile being assigned a recall interval of > 7 months.
Considered to be CPG adherent in adults were patients with low-risk profile being assigned a recall interval of ≥ 9 months and adult high-risk patients being assigned a recall interval of < 9 months.
Secondary patient outcome measures collected concerning bitewing (BW) frequency:
Considered to be CPG adherent were all patients with a high-risk profile being prescribed frequencies of BWs ≤ 24 months, and patients with a low-risk profile in both age groups, frequencies of ≥ 36 months.

Intervention

Participating GDPs in both trial arms received an identical implementation program. The implementation strategy comprised a web-based patient vignettes training, the dissemination of a CPG by mail (with reading instruction), and an interactive IQual group meeting of approximately three hours. At these meetings, the selected intervention topic was discussed and a risk-based decision-making process guided by the CPG was offered. Topics regarding risk management, such as identification of risk factors/indicators, preventive interventions, prognosis, monitoring, and record keeping were presented. In addition, all participants received feedback on individual as well as group scores concerning the online risk-based patient vignettes assessments. During two months no trial activities were planned. Reminders with topical information and flow diagrams were provided two months before post intervention measurements. Flow diagrams comprised algorithms of CPG decision-making aspects related to allocated trial arm.

Data collection

All patient data on the intervention topic were collected using patients' records and special registration forms to be completed by GDPs. Each GDP was asked to select on a random working day eight to ten consecutive patients scheduled for ROE and to complete at least 20 registration forms at baseline as well as at post intervention measurements. Questionnaires, patients' records, and registration forms provided information to assess the outcome parameters. The structured registration forms were tested and used in a previous clinical case recording study (7) and related to three domains: patient history data, clinical findings from current examination including

relevant risk factors/indicators and finally disease prognosis/prediction and intervention type (preventive respectively operative).

Statistical analysis

Descriptive statistics included frequencies, percentages, means, and standard deviations. Group, professional and patients' characteristics of GDPs were compared using Student-t-test and a non parametric test (Mann-Whitney U test) for continuous variables and an X^2 analysis for proportions. $P < 0.05$ was considered to be the level of significance. We performed a multilevel logistic analysis to assess effectiveness, adjusting for clustering of patients in GDPs. Intraclass correlation coefficients were calculated to rate the degree of clustering. Generalized estimating equation models were constructed with a Glimmix procedure, using SAS statistical software, version 8.2 for Windows (SAS Institute). For each indicator outcome, the basic model included effects on the intervention group versus the control group and on timing of measurement (pre-intervention vs. post-intervention). The model also included the interaction between these two variables. The adjusted estimates and their associated standard errors were converted to Odds ratios (ORs) with 95% CIs. Due to the high- and low-risk patient outcome measures, a planned subgroup analysis was conducted.

Table 1. Patient characteristics (absulute numbers and percentages between brackets) in intervention and control arm for baseline and post intervention measurements

Patient characteristics	**Baseline cohort***		**Post intervention cohort***	
	Intervention (n=643)	**Control (n=519)**	**Intervention (n=608)**	**Control (n=531)**
Gender				
Female	316 (49.1)	298 (57.4)	327 (54.6)	265 (50.8)
Male	327 (50.9)	221 (42.6)	271 (45.4)	251 (49.2)
Age				
0–18 yr	123 (19.2)	96 (18.6)	105 (17.2)	91 (17.1)
18 +yr	519 (80.8)	423 (81.4)	503 (82.8)	440 (82.9)
Oral health status				
Dental Caries				
Low-risk:				
No disease experience	138 (21.8)	125 (24.5)	149 (24.5)	119 (24.3)
Disease experience, 2 yr disease-free	207 (32.7)	185 (36.3)	223 (36.7)	193 (37.0)
High-risk:				
Dental caries condition	288 (45.5)	200 (39.2)	235 (38.8)	201 (38.7)
Periodontal Disease				
Low-risk:				
No disease experience	275 (43.7)	217 (42.3)	243 (40.6)	232 (43.5)
Gingivitis	255 (40.4)	206 (40.2)	275 (45.2)	218 (41.9)
High-risk:				
Periodontal disease condition	100 (15.9)	90 (17.5)	86 (14.2)	70 (14.6)

*: small differences in total numbers of described patient characteristics are due to missing values.

Results

Study population

Initially, nine peer groups were recruited. Two peer groups refrained from further participation resulting in randomisation of seven peer groups to one of the trial arms, 4 groups in the intervention arm and 3 groups in the control arm. At baseline, the intervention group consisted of 643 patients and 519 patients were enrolled in the control group. The post intervention groups included 608 intervention patients and 531 patients in the control groups (Figure 1). Six patients were excluded because of incomplete recording of data on registration forms. In the intervention, arm 3 GDPs were lost for follow-up, whereas in the control arm all participants finished the trial. Significant clinical differences in included patients between intervention and control groups were not detected at baseline nor post intervention for dental caries as well as periodontal disease in low and high risk groups (Table 1). Differences in characteristics of GDPs in peer groups between intervention and control arm were not significant except for the 'the number of patients in practice' (Table 2).

Table 2. General dental practitioners (GDPs) personal and practice characteristics in both trial arms (ROE= routine oral examination, MIM= mandibular impacted molars)

GDP characteristics	**Intervention groups ROE (n=24)**	**Control groups MIM (n=24)**
Personal		
Proportion of male (s) (%)	87.5%	75.0 %
Mean age in years (SD)	47.4 (8.9)	47.8 (9.7)
Mean number of years in practice (SD)	22.7 (8.7)	21.4 (9.0)
Mean number patients in practice (n)* #	4,507 (4,907)	2,977 (2,661)
Median number patients in practice (n)	3,000	2,500
Practice		
Mean total working hours/per week (SD)	37.8 (8.1)	37.5 (7.6)
Mean chair side working hours/per week (SD)	31.6 (7.2)	30.8 (5.4)
Mean management hours/per week (SD)	6.2 (3.4)	6.7 (4.1)

*: The number of registered patients attending the dental practice at least once a year.
#: Significantly different between intervention and control group ($p < 0.05$).

Effects

Table 3 shows the baseline- and post-trial measurements of intervention and control group concerning the primary outcome measure for recall interval assignment regarding the performance of high or low-risk groups for disease. Table 4 shows the performance concerning bitewing frequency prescription in intervention and control group for both risk subgroups.

Overall guideline adherence

Overall CPG adherence for recall assignment at baseline was 55.5%, and for post-intervention performance 53.6%. Regarding bitewing frequency prescription at baseline 63.4%, and post intervention 62.3%.

Guideline adherence for high- and low-risk patients

Substantial CPG adherence percentages in both trial arms were found at baseline and post intervention in high-risk patients for recall assignment (between 88.8% and 97.9%) and low adherence percentages in low-risk patients (between 10.8% and 28.5%), (Table 3).
Regarding bitewing frequency, low guideline adherence percentages were found before and after the intervention in high-risk patients (between 17.1% and 41.8%), whereas in low-risk patients CPG adherence was found to be high (between 69.1% and 86.6%), (Table 4).

Table 3. Percentages of guideline adherent recall interval decisions (%) at baseline and post trial for both trial arms with absolute change, 95% confidence intervals (95% CI) and interaction coefficient (IAC) for the high- and low-risk patient groups

Primary patient outcome									
				Recall interval					
Intervention group (ROE)				**Control group (MIM)**				**IAC (95% CI)****	**P**
Baseline N=615	Post N= 595	Absolute Change	OR* (95% CI)	Baseline N=496	Post N=517	Absolute Change	OR* (95% CI)		
High-risk group									
N=327	N=268			N=231	N=240				
293/327 89.6%	238/268 88.8%	- 0.8%	1.02 (0.62–1.70)	220/231 95.2%	235/240 97.9%	+2.7%	2.34 (0.77–7.30)	0.35 (0.66–8.48)	0.19
Low-risk group									
N=288	N=327			N=265	N=277				
58/288 20.5%	93/327 28.5%	+ 8.0%	1.88 (1.22–2.89)	45/265 16.9%	30/277 10.8%	- 6.1%	0.56 (0.33–0.99)	0.30 (0.15–0.61)	0.00

* ORs were adjusted for clustering of patients relative to GDPs in a multilevel analysis.
** IAC= Interaction coefficient = effect measure = ratio of OR-MIM and OR-ROE (95% CI).
OR-MIM = (number correct after/ number incorrect after)/(number correct before /number incorrect before).
OR-ROE = (number correct after/ number incorrect after)/(number correct before /number incorrect before).

Differences in guideline adherence for high- and low-risk groups

Recall assignment: Concerning the rate of guideline adherence for the high-risk patients, the intervention group hardly changed performance (-0.8%), while the control group showed a slight

increase (+2.7%). This difference was not statistically significant (p = 0.19). Regarding low-risk patients, the rate in guideline adherence increased with 8% from 20.5% to 28.5% (OR: 1.88; 95% CI: 1.22–2.89) in the intervention group, which effect was significantly different compared to the control group (p= 0.00) (Table 3).
Bitewing frequency: In high-risk patients, guideline adherence slightly decreased with -1.3% (OR: 1.14; 95% CI: 0.62–2.13) in the intervention group, and a substantial increase of +24.1% adherence was found in the control group (OR: 4.24; 95% CI: 1.68–10.73). The guideline adherence did hardly change (-1.1%) in low-risk patients in the intervention group (OR: 1.20; 95% CI 0.78–1.84), while a considerable decrease of -17.5% was found in the control group (OR: 0.19; 95% CI: 0.11–0.33), which difference was statistically significant (p< .0001) (Table 4).

Table 4. Percentages of guideline adherent bitewing frequency decisions (%) at baseline and post trial for both trial arms with absolute change, 95% confidence intervals (95% CI) and interaction coefficient (IAC) for the high- and low-risk patient groups

Secondary patient outcome									
				Bitewing					
Intervention group (ROE)				**Control group (MIM)**				**IAC (95% CI)****	**P**
Before N=477	After N=491	Absolute Change	OR* (95% CI)	Before N=308	After N=418	Absolute Change	OR* (95% CI)		
High-risk group									
N=157	N=140			N=76	N= 68				
48/157 30.6%	41/140 29.3%	-1.3%	1.14 (0.62–2.13)	13/76 17.1%	28/68 41.18%	+24.1%	4.24 (1.68–10.73)	3.69 (1.05–11.25)	0.02
Low-risk group									
N=320	N=351			N=232	N= 350				
236/320 73.7%	255/351 72.6%	-1.1%	1.20 (0.78–1.84)	201/232 86.6%	242/350 69.1%	-17.5%	0.19 (0.11–0.33)	0.16 (0.08–0.32)	<.0001

* ORs were adjusted for clustering of patients relative to GDPs in a multilevel analysis.
** IAC= Interaction coefficient (effect measure) =ratio of OR-MIM / OR-ROE (95% CI).
OR-MIM = (number correct after/ number incorrect after)/(number correct before /number incorrect before).
OR-ROE = (number correct after/ number incorrect after)/(number correct before /number incorrect before).

Discussion

This trial showed small to moderate effects in planned patient's subgroups in adherence to the ROE-intervention guideline. This finding has to be understood in the context that the implementation of evidence based CPGs in general dental practice in The Netherlands is still in its infancy (37). The primary outcome measure, most in need for improvement, i.e. recall assignment in low-risk group, showed a small improvement.

Looking at the results of this trial, the small improvements in GDP guideline adherence in the intervention group are in line with conclusions of previous review research data (25-26) in general health care concluding that improvements in general are small to moderate (8-10%). Data of multifaceted intervention trials to improve professional performance in dentistry are limited (35, 38), so we cannot compare our results with those of other studies in dentistry.

An eye-catching result was found in the considerable increase in CPG adherence in the control group concerning bitewing frequency for high-risk patients as well as the substantial decrease in GPG- adherence concerning bitewing frequency for low-risk patients. Clinical performances in both risk categories suggest an overall increased bitewing radiograph frequency. This might be explained by the so called Hawthorne effect (39), this means that people's behaviour and performance change following any new or increased attention. As being part of a trial, GDPs might have paid more attention to a ROE. This might probably also have occurred in the intervention group, but this effect could probably be perished by the educational intervention on this topic. We considered the discussion with regard to the questions concerning the power of this trial, as described in the study protocol (36). Power calculation was conducted based on the total number of recordings per trial arm, and not for the high- and low-risk subgroup outcome measures separately. However, the findings of this study indicate that the study did not suffer from lack of power.

Some remarks can be made concerning contextual aspects of this study. The CPGs used in this study had not yet been implemented nationwide and GDPs are not familiar in working with evidence based CPGs, simply because they are not as yet developed and available in Dutch dental care. In 1998, opinions of GDPs concerning the use of clinical guidelines in general practice (39), showed that nationwide 50% of the dentists were reluctant to work with clinical CPGs for many reasons and this percentage today is still about 40% (41).

GDPs probably did not experience standardised recall of patients as a clinical problem. In contrary, such a policy provides a firm economical basis, creates a relatively straightforward scheduling (planning) of patients, saves time and creates a position to be always on the safe side in case things may go wrong. Furthermore, the organisation of oral health care delivery in general practice is characterised by a so-called 'family-based' visit pattern, which is highly appreciated by regular attending families and does not stimulate towards individually scheduled recall visits. In conclusion, recall periods seemed to be not really a bottleneck for neither GDPs nor for regular attendees.

Another potential barrier to prevent patient-tailored risk management is directly related to organisational aspects in dental practice. Potential barriers appeared to be the lack of time, the lack of scientific evidence and suitable software for recording data. The easy and efficient recording of risk factors/indicators and other risk related aspects for risk assessment can not adequately be performed, given the current software packages available in Dutch general dental practice. The absence of such organisational facilities probably explains the variation in recording of data related to individual risk profiles in this study. Furthermore, the number of IQual groups was probably limited due to the time-consuming data collection method and the

inexperience of GDPs to participate in practice-based research.
We designed our study to assess changes in performance on the basis of patient outcome parameters. To assess the process of oral care, several indicators for risk-based management leading to an outcome aspect (recall interval length) most relevant for the effect should also be analysed. Given the preliminarily status of the ROE-CPG, we were not able to develop clinical performance indicators for this study. This limitation should be envisaged because the developed process indicators could be relevant to detect flaws in risk management.
The participating peer groups may not representative for Dutch general practice. They represented GDPs who are motivated to discuss clinical problems with counterparts and are intended to improve their knowledge in a structured way. They acknowledged the importance and impact of a life long learning attitude. On the other hand, especially peer groups are frequently confronted with all kind of innovations, resulting in 'performance change' overkill. Further data analysis of the trial should focus on differences in performance between groups or individual GDPs, which could reveal information on specific implementation barriers in daily practice.
For clinical practice, extensive efforts should be made to design software packages for more user-friendly data collection on risk management aspects. Furthermore, selecting low risk patients for oral disease tailored to extended recall periods gives the opportunity to delegate ROE screening for a substantial group to co-workers (dental hygienist, dental nurse practitioners) in the dental team. Time will be released for GDPs to focus on risk management aspects of high-risk patients.
Further research should be focussed on effective nationwide implementation methods of CPGs, especially on potential barriers in general dental practice, starting with the rigorously development of quality process of care indicators to measure performance change. Simultaneously, efforts should be made to implement patient-tailored risk management early in dental education at the undergraduate and postgraduate level.

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General discussion and conclusions

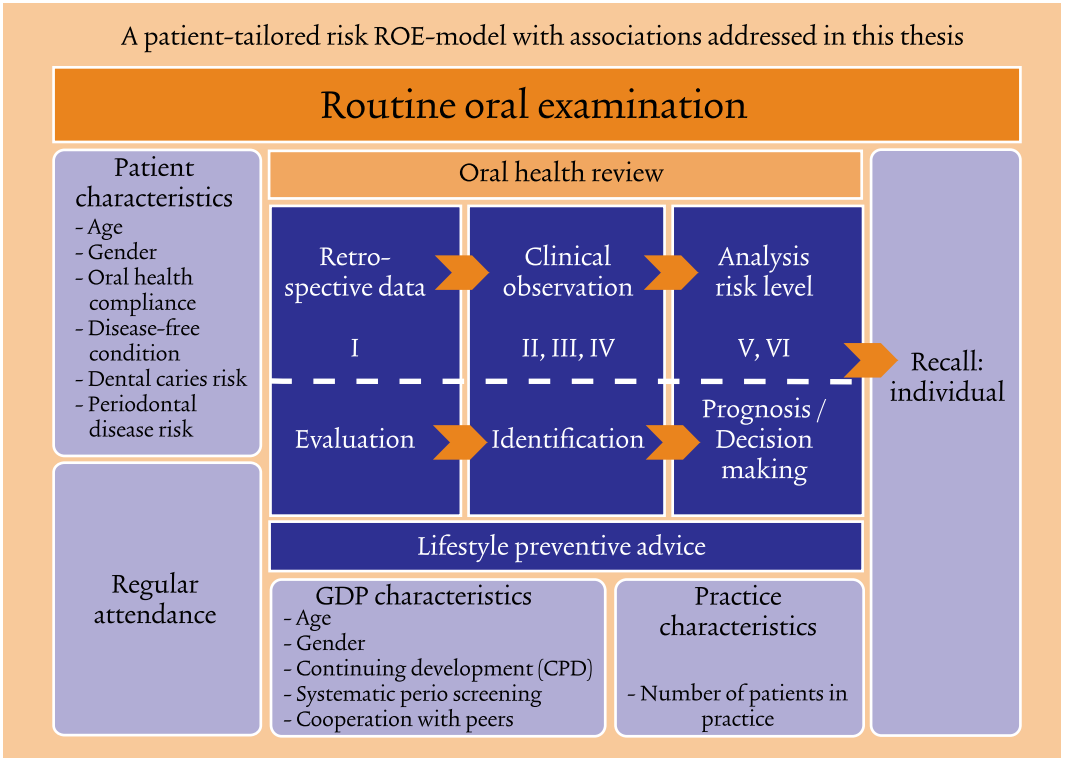
Introduction

The main objective of this thesis was to examine routine oral examinations (ROEs) in primary oral care, focussed on individual risk management resulting in variable recall intervals. Oral health in The Netherlands improved substantially in the past three decades and dental practice has faced a growing number of regular attendees with an optimal oral health condition. The quality of oral care provided to regular attending patients is subject of ongoing debate and raises many questions. The thesis aimed to explore patient-, general dental practitioners (GDP) -, and practice characteristics contributing to a patient-centred oral care delivery, based on an individualised risk surveillance approach. Since this area of research in general dental practice is fairly unexplored, the research conducted is mostly explorative in nature.

This chapter presents the general discussion, highlights some methodological issues and elaborates on the implications of the research for dental practice and education, health policy and future research. Based on the studies performed in this thesis and considering the scientific evidence found, the patient-tailored risk model (Figure 1) was further elaborated with definitions and clinically relevant risk management steps. Routine oral examination refers to periodic data collection on general and oral health of patients. In comparing recorded data from a ROE to those obtained from previous examinations or to known references, disease onset or progression can be diagnosed and predicted. The purpose of ROE is to prevent oral disease (primary prevention), or to detect oral disease at an early stage in order to arrest the progression of disease (secondary prevention), using minimal interventions and providing preventive advice and feedback on lifestyle aspects. The best available evidence to predict future disease onset is previous disease experience (Chapter 6). GDPs clinical judgement and the ability to combine risk factors based on knowledge and reliable information collected during ROEs is still considered to be the best available clinical method to predict disease onset or progression (1). The diagnostic performance of GDPs on a patient level is directly influenced by progression rates of various oral diseases as well as by the involvement of multiple risk factors causing a specific disease. Selection of the main risk factors/indicators leads to a specific patient risk profile. A risk profile is a predefined level of risk for different types of oral disease as a result of exposure to certain risk factors/indicators. Every time a patient attends for a ROE, decisions have to be made on various individual assessments related to disease progression concerning dental caries, periodontal disease, tooth wear and oral cancer, the timing of additional radiographs, and risk management of developing wisdom teeth. These assessments and decisions should be re-assessed and documented with consequences for each assigned recall period. Hereby, three main steps are involved: the oral condition in history (retrospective analysis), the actual oral condition (identification) and the estimated condition in the near future (prognosis/prediction).

The following successive oral health review steps determine this process of disease risk management:

I. Retrospective analysis of previous risk profile as documented in patient record
II. Oral health assessment to identify risk factors/indicators of disease and protective factors
III. Assessment of the impact of potential risk factors on disease history and actual condition
IV. Timing bitewing radiographs and preventive intervention(s)
V. Classification of the actual risk profile in patient record
VI. Decision on patient-tailored recall interval



Discussion

Opinions

One of the starting points to conduct this research project was the changing nature and role of ROE in general dental practice. GDPs are uniform in their opinion that ROE can be considered as the cornerstone of individual prevention, and the majority of GDPs (> 84%) also underpinned the opinion that ROE is an excellent instrument for delivering effective individual oral care. In spite of these clear-cut statements, the majority of GDPs recalled patients at fixed six-monthly intervals, suggesting that an individual recall period in their opinion was not directly related to delivering effective individual oral care. Nevertheless, Dutch GDPs differ in the way they dealt with the determination of recall intervals. Over a 5-year period, the results suggest a tendency from predominantly fixed towards more individualised recall assignment behaviour. However,

we were unable to explore the basis of a patient-tailored risk strategy related to individual recalls. GDPs reported to reckon with various risk factors but any relation with the length of the recall period was not found. It suggests that other non-clinical factors, not explored in this study, probably influence recall assignment in daily practice.
A substantial part of Dutch GDPs supported standardised clinical behaviour concerning number of examinations, bitewing frequency, time spend and especially recall intervals. This strategy, decades ago probably very effective when dental caries occurred in nearly all regular attendees, became common practice. Compared to international professional standards, this approach is rather exceptional. In Finland, mean recall periods from 12-15 months are most common (2, 3), and Finnish experts advise children and adolescents with low caries risk recall periods extending from 1.5 to 2 years, without jeopardising the oral health status (4). For low risk individuals the lengthening of recall intervals would reduce treatment and examination times by 15% (4-6). Originated from common professional working styles, regular attendees have got used to 6-monthly recalls. The requirement to visit the dentist for a ROE every six months was replaced in 1995 by the obligation to get a ROE no more than once a year. The patient survey (Chapter 3) addressed the question what regular attendees do think about this change in policy and whether they prefer the one (fixed) to the other (individualised). Patients apparently depended for the greater part on the professional judgements of GDPs over the last decades, which is not really surprising given the efforts made by both to improve oral health maintenance over the last decades. Gender differences were in concordance with other studies (7, 8), suggesting that female attendees are keen on prevention and oral health maintenance. Unfortunately, the response rate of this study was fairly low, limiting the conclusions that could be drawn from the results of this study. Further research on patients' preferences on clinical issues is needed and shared recall decision-making should be encouraged to improve patients' involvement in their oral care (9). Thereby, transparency of information (accessible, comparable and reliable) concerning quality and costs of provided oral care are key items. In the near future, this could be accomplished in a national Patient Data Station project, collecting periodically patients' opinions concerning oral health related topics.

Professional performance

In the clinical case-recording study (Chapter 4), a substantial variation was found between GDPs in the way they conduct ROEs in patients with different risk profiles. Ideally, it should hardly make any difference, which GDP is conducting a ROE assuming that patient characteristics would be rather decisive for the outcome. The clinical case-recording studies (Chapter 4 and 5) showed explicitly that, besides relevant patient factors, GDP factors were responsible for differences in clinical behaviour. This variation in clinical decision-making was confirmed by previous research in oral care (10-15). The clinical case-recording study showed that patient's oral condition was not reflected in the length of the assigned recall interval. Explanations for this variation may be found in time management and efficient practice organisation, patient preferences, peers-accepted practice routines, and last but not least in financial incentives related to the reimbursement

system. Historically, GDPs are focussed on disease detection rather than on risk management. Identifying relevant risk factors and recording patient data is time consuming and predicting oral disease is a rather complex process. In view of the lack of a gold standard for individual recall periods, a policy to be always at the safe side has probably become usual practice for a substantial part of Dutch GDPs.

ROE is considered as a 'patient-tailored systematic surveillance' approach, and we would expect that patient characteristics like 'age', 'oral health condition', and 'oral health compliance' would be the most relevant determinants for ROE behaviour. Our results (Chapter 5) confirmed this, suggesting that current practice is at least consistent with the prevailing insight in ROE. GDPs are experienced implicitly in focusing on the main risk factors/indicators for oral disease, but the way they are dealing with the information gathered, varies substantially. A patient-tailored surveillance approach was far from generally accepted. The minority of GDPs, which adhered to this approach, were in support of life long learning activities (peer groups, continuing professional development and cooperation within dental practice) and strongly focussed on systematic periodontal screening. This implies that efforts to implement ROE performance innovations in the short-term should have the greatest impact when addressed e.g. in GDPs peer groups. In the long-term, undergraduates in Dental schools should be educated in life-long learning quality aspects as part of their professional performance.

GDPs' age appeared to be not a salient predictor, suggesting that clinical expertise did not predict clinical behaviour. Unfortunately, frequency of radiograph (bitewing) prescription over time could not be evaluated, because the case-recording was limited to one patient encounter only. This implies for future research the need for 'longitudinal' clinical case-recording, preferably in a 'controlled' research network of dental practices provided with appropriate data recording software. After all, clinical case-recording could yield substantial data on performance. One of the limitations could have been the lack of experience of GDPs in filling out directly on registration forms. Another barrier could have been the possibility to easily retrieve electronically documented patient data. Software packages mostly used in dental practice were not adjusted to straightforward (risk-related) patient data collection.

The construction of recording forms applied in this study was based on three main oral health review domains, as prescribed in a patient-tailored risk model (Figure 1). It has been quite a challenge to develop recording forms that were not too extensive for use in daily practice, but yet specific enough to retrieve optimal information. To analyse ROE management aspects regarding bitewing radiograph frequencies, future research should comprise practical and conscientious data collection concerning history data, current clinical observations and the timing of bitewing radiographs (BWs).

Unfortunately, a practical dental caries score index to describe treatment needs and to monitor disease progression in young adults is not available yet. In order to develop such a score index, GDPs should document individual disease activity and progression of dental caries in patient records, which at this moment is quite a challenge. Regarding periodontal disease, a Dutch Periodontal Score Index ('DPSI') is applicable for daily practice, nevertheless not generally used

(Chapter 4). Although not formally validated, it is an instrument to monitor periodontal health status over time conducting ROEs in daily practice. Further research in the development and validation of disease risk score indices is needed to enable more consistent risk management.

Evidence base and ROE guidelines

A limitation experienced in this research project was the lack of scientific evidence on ROEs. As a result, reliable statements on (cost)-effectiveness issues like recall intervals and prophylactic third molar removal were not possible. Randomised clinical trials are the preferred study design for the assessment of the effectiveness of most health-care interventions. The systematic review on effectiveness of ROEs (16) and the conducted review on prophylactic removal of third molars (Chapter 7) were highly uniform in their conclusions: Both underpinned the paucity of good quality clinical research evidence. The lack of randomised studies on (cost)-effectiveness of recall assignment and third molar management raises questions with regard to future randomised study designs in this field. Research on multifaceted interventions such as ROE is complex. It covers many aspects of screening, diagnosis, and preventive interventions for various conditions within different subgroups. Insight in the various components of the preventive performance, for example, content of oral examination, length of follow-up period, is too limited or unknown to define an optimal trial design. Such trials have to be conducted for relatively long periods of time and with sufficient participants. In view of the various progression rates of multifactorial diseases such as dental caries and periodontal disease, loss of follow-up is an important threat to the validity of such studies. The use of a generic clinical outcome measure may help to tackle the problem of heterogeneous outcomes. A comparable research problem occurred in the study on effectiveness of surgical removal of wisdom teeth. The onset of disease is measured in the group of subjects in which the third molars are retained. A reasonable evaluation period to measure the prevalence of disease in the retention group would be 20 years, although relevant information may be apparent by 10 years. Beside the problem of long-term funding, loss of follow-up is than a serious threat.

Also, quality of life outcome measures could be used for effectiveness studies on ROEs and third molar management. Little evidence was available, especially on longitudinal trials and measurement of change. Interpretation of change scores continues to be a challenge (17). Future research in this area has to deal with the question which oral health related quality of life measure is most appropriate to assign. Also, an alternative approach could be found in designing longitudinal cohort studies conducted in a well-organised research network of dental practices. There is little scientific evidence on effectiveness of oral health promotion and preventive approaches, as integrated part of ROEs. The decline in oral diseases is considerable and compliance to maintain optimal oral health has improved. Nevertheless, a specific group of susceptible individuals is still experiencing severe oral health problems. Besides possible resource allocation, the rationale behind individualised recall intervals lies more in maintaining equalities in oral health. The implementation of a preventive patient-tailored caries risk strategy in clinical practice showed beneficial effects (18-20) as well as minor to no additional benefits (21, 22).

In adopting a patient-tailored risk strategy, the application of a population based strategy and vice versa should not be excluded. Research on alternative preventive strategies, especially common risk factor approaches (23), addressing risk factors most common to many chronic disease conditions (heart disease, obesity, stroke, diabetes) should be advocated to prevent further inequalities in oral health.

Clarity and transparency are contemporary concepts in modern health care. Initiatives from patients and other stakeholders to gain insight in the structure and process of oral care are inevitable. Rigorously developed CPGs and derived quality indicators could contribute to improved transparency in clinical oral care. In The Netherlands, the development and implementation of evidence-based CPGs in general dental practice is still in its infancy (24). In 1998, opinions of GDPs concerning the use of CPG in general practice showed that nationwide 50% of the dentists were reluctant to work with clinical CPGs for many different reasons (25), and this percentage today is still about 40% (26). Remarkably, there are quite some scientific associations, but only a few developed CPGs as part of their quality improvement activities. Guideline development is time consuming and expensive, and adequate financial and human resources are a prerequisite for success. Substantial efforts in dentistry should be made and a national organisation or institution responsible for structural quality improvement in general dental practice is highly advocated.

The limited available scientific evidence on risk management aspects of ROEs eventually resulted in an evidence-based CPG. CPG recommendations were strongly determined by expert opinions. Such a CPG is rather vulnerable for professional comments and discussions, and as a consequence, guideline adherence rates are probably limited (27). Despite this limitation, evidence-based CPGs could provide professionals insight in various decisions and treatment strategies. This enables peer groups to discuss and assess recommendations leading to 'best practices' concerning a patient-tailored approach. Peer groups should be encouraged to modify national CPGs into 'own' local clinical guidelines and training in qualitative principles of CPGs should be part of undergraduate and post-graduate dental education.

It is encouraging that our initial research efforts, showing that instruments – a CPG as well as a set of patient vignettes – developed were well-accepted by motivated dental professionals. To develop these instruments in a structured way, participants of various fields in dentistry were recruited and completed the entire procedure of nearly two years. Each of the 31 members of both expert panels, conducting the RAND-modified Delphi procedure has spend between 7 to 11 hours, while only three did not complete the procedure. Finally, to conduct a cluster-randomised controlled trial, 51 general dental practices were involved and 48 of those practices were still participating at the end of the nine-months-trial. GDPs participating in this trial were unanimous in their evaluation statements: the most accepted and appreciated part was the interactive educational meeting, and less accepted was the time-consuming recording of patient data in daily practice. Integrated into the process of guideline development, we constructed a representative set of 19 risk-based patient vignettes, comprising children-, adolescent- as well as adult vignettes. As found in previous medical research, patient vignettes showed to be a reliable instrument to assess and

guide clinical decision-making in case of insufficient evidence (28-31). For undergraduate dental education as well as for clinical practice, risk-based patient vignettes could be used for educational purposes (national guideline implementation), to promote risk management behaviour, assess decision-making and provide feedback to patients for shared decision-making. We used the patient vignettes in peer group assessments with opinion leaders and educational feedback on individual and peer group level. The participating GDPs highly appreciated to discuss their performance in small group sessions, showing the potential benefits of these kind of educational encounters for behaviour change (32). Using these online vignettes, potential barriers for a patient-tailored risk strategy could be explored by conducting educational assessments in GDPs' peer groups. Furthermore, lessons could be learned from the experiences in primary health care concerning multifactorial heart disease risk management (33). Specific risk management aspects delegated within the dental team towards competent co-workers responsible for risk factor monitoring is rather straightforward to achieve, given the various professionals occupied in general dental practice. However, research on the structure of team care models and competences of different professionals in primary oral care is lacking (34).

Implementation of innovations

In contrast to general medical practice, implementation of CPGs in dental practice is relatively new. To conduct a cluster-randomised trial in general dental practice, substantial efforts have been made to collect peer groups for the enrollment in the clinical trial. On the other hand, most GDPs in the participating peer groups, fairly inexperienced in practice-based research, which started did also complete the trial. The results of this trial showed small to moderate effects in planned patient's subgroups in adherence to the ROE guideline. Factors responsible for changing practice routines in dental care are unknown. Data from medical research (35) showed that potential barriers for guideline adherence might be related to the professional workers (attitude, knowledge, and skills), the social context (attitudes of colleagues, opinions of patients), the organisational context (practice organisation, time and resources) and the CPG themselves (relevance, evidence and complexity) (36). Knowledge regarding the barriers for improvement is essential for effective implementation programs. A number of potential barriers have to be faced in implementing an innovation towards a patient-tailored risk strategy in primary oral care. A standardised ROE performance reflected in fixed recalls and bitewing frequencies as conducted in general dental practice is probably not seen as a clinical problem by GDPs and patients as well. This is a predominant barrier in efforts to change clinical behaviour (37). The initiative for behaviour change in clinical practice should be originated from the dental professional, in providing contemporary quality oral care adapted to the individual needs of patients. Quality improvement instruments mostly used in dentistry are traditional continuing dental education and structured peer group meetings (38). There exists no mandatory system for continuing dental education for GDPs in The Netherlands, in contrast with other Western countries (39, 40). CPG according to AGREE-criteria (41) and rigorously developed quality indicators to measure clinical behaviour and improve quality of care are not applicable for measuring clinical performance.

With respect to the organisational context, potential barriers appeared to be the lack of scientific evidence, suitable software and predominantly time for recording data. The easy and efficient recording of risk factors/-indicators as well as risk classifications cannot be performed adequately with the current software available in dental practice. The absence of such organisational facilities probably explains the variation in recording of data related to individual risk profiles of patients in studies conducted in this thesis. This thesis intended to explore clinical performance of GDPs concerning ROEs in the context of the decreased prevalence of oral disease. Given the results, i.e. fixed recall intervals for the greater part of patients, content of ROEs strongly predicted by GDP characteristics, and a substantial variation in clinical ROE performance, implementation of patient-tailored innovations are required to improve quality of primary oral care. To promote an effective and efficient transfer from research findings into clinical practices, besides CPGs, additional approaches should be accomplished, in which dental research should focus on clinical relevance and problems experienced by practitioners in routine oral care of patients. Therefore, clinicians and researchers should be linked together in practice research networks (42-44).

Methodological considerations

Clinical case-recording studies

Obviously, the recording studies had strengths and weaknesses. To measure clinical performance, several data sources have been described, including medical record reviews, and health insurance company databases (45-47). Although not formally validated, it leads to reasonably valid recording. Alternative methods are self-reporting and clinical observation; the last method is suggested to be the gold standard (43, 48). The increased data-yield is the most significant advantage of clinical case recording with as a result a more complete clinical decision review (49). In general dental practice, recording multiple patient data is not current practice. Therefore, self-recording was determined as the most appropriate study design. Structured record forms might probably guide GDPs in a directive way, causing bias due to the structure and composition of the record forms. Relatively high intracluster coefficients (ICCs) were found, compared to primary health care coefficients (50, 51). Comparison with other data is not possible given the lack of primary oral care ICCs. Dutch GDPs are not familiar with practice-based research, and probably they might be reluctant to studies evaluating individual clinical behaviour. The present study showed a relatively low participation of the GDPs eligible, which could be used to question the validity of our results. However, the actual GDP study group was compared with the non-participants, and significant differences between participating and non-participating GDPs were only found in the higher percentages of participating GDPs who stated that they assign individualised recall intervals.

Patient vignettes

We intended to validate the patient vignette model, but failed to do so because an analysis of variance of the influence of specific risk factors/indicators on recall length decisions per vignette showed that certain risk factors were strongly correlated (one to one confounding). The total number of assessments made by both expert groups was too small to be reliable for

statistical analysis and prevented a straightforward regression analysis with applied risk factors as independent and assigned recall periods as dependent variables. Only strong correlation coefficients (negative) emerged between specific risk factors and the assigned recall periods, suggesting that risk level and recall length were correlated to each other. Applied in a scientific context, further long-term validation studies should be carried out to test the reliability of this set of vignettes in measuring risk-based oral screening.

Cluster randomised trial

The effects of the intervention were assessed in a randomised controlled trial taking the design effect of cluster randomisation into account. The results of the trial could be affected by a number of potential limitations:

Peer groups participate voluntarily; they may have been more interested in the topic under investigation and may represent a selected group of dental professionals. The recruitment of peer groups was a time-consuming process in which eventually seven groups after repetitive advertisement were enrolled in both trial arms. The follow-up period of this trail was 9 months. Given the lack of experience working with CPGs in dentistry, we did not know how long favourable changes adapted were lasting.

Little evidence was available on the estimates of the likely size of dental primary care ICCs, and which prognostic factors influenced their magnitude. Based on earlier research, we assumed a substantial variation in primary oral care between fairly autonomous GDPs. Data extracted from primary health care suggested that ICCs for patient outcomes in primary care were generally less than 0.05 (50, 51). In reviews of this protocol (Chapter 9), questions were raised about the power calculation. In particular, the expected effect size was seen as large. This would imply that the power calculation was too optimistic, and that the study might be underpowered to detect meaningful changes in professional behaviour.

We considered the discussion with regard to the questions concerning the power of this trial, as described in the study protocol (Chapter 9). Power calculation was conducted based on total number of recordings per trial arm, and should probably been done in the future counting for the high- and low-risk subgroup outcome measures. All in all, the findings of this study indicate that the study did not suffer from lack of power.

Conclusions:

Section I. Dentist reports and patient reports on current practice

- Patients prefer in general a systematic 6-monthly recall interval for ROE.
- Dutch GDPs differ in the way they deal with the assignment of recall interval: either fixed or individualised.

Section II. Assessing professional performance

- Recall assignment, mostly 6 months is a more or less standardised procedure, independent of the oral condition of patients.
- GDP-characteristics predict the content of ROEs, suggesting different working styles.
- The variation found in clinical behaviour between GDPs is substantial, implying the need for ROE guideline development.

Section III. Evidence-based recommendations

- High-quality studies to provide a solid evidence base for clinical practice concerning the effectiveness and risk assessment of ROEs are lacking.

Section IV. Enhancing patient-tailored risk management

- The development of a clinical practice guideline and patient vignettes on ROEs were successfully completed and used.
- CPG implementation using a multifaceted peer group intervention showed small to moderate effects regarding recall interval guideline adherence.

Implications for research

Implementation

First of all, future research should focus on an effective nationwide implementation of the ROE CPG, taking into account potential barriers in general dental practice. Simultaneously, efforts should be made to implement patient-tailored risk management in undergraduate dental education. Multiple and continuous efforts may lead to greater effects. Special attention should be paid to the lack of CPGs used in daily practice as quality improvement instruments and how dental professionals are going to meet requests from patients and organisations concerning transparency of oral care services.

Qualitative study designs like semi-structured focus group interviews within the dental team could probably yield more information in what way and to what extent a patient-tailored risk strategy should be part of ROEs. One of the main obstacles in a patient-tailored risk strategy is an easy and efficient recording of risk related data with the current software packages in general dental practice. Research on user-friendly software packages and the development of practical oral indices to describe treatment needs for various members of dental team is highly needed.

The selection of patients implies preventive strategies focussed on high-risk patients groups. Research on additional preventive strategies in cooperation with other primary health care professionals, taking into account the common risk factor approaches, should be promoted.

In the meantime, 'preventive' CPGs should be further developed for the dental team to provide

effective preventive oral care for specific patient groups. To improve preventive interventions, the 19 patient vignettes developed in this thesis could be upgraded with recommendations for evidence-based preventive clinical performance in general practice.

Practice-based research

Primary oral care research directly meets the principles of evidence-based health care. Research is problem-based and focussed on clinical performance directly related to real-life situations. Implementation of innovations in daily practice, due to the specific partnership between science and practice, could be more easily achieved.

Practice-based research, implying recurrent data collection within a selected group of general dental practices ('research network'), should be promoted. Such a network of practices could be provided with user-friendly software and instructions for data collection, thus saving time and providing more consistent data on performance and management of ROE.

Conducting randomised clinical trials on recall strategies related to multifactorial oral diseases is rather expensive, needs substantially efforts of funding and human resources. For the near future, given the limited resources available in dental research, efforts should mainly focus on large-scale observational studies in general dental practice. Clinical case-recording studies are promising, given the substantial data-yield on actual clinical performance.

Further validation research is needed to deliver more data on the reliability of the set of risk-based patient vignettes used for educational purposes, and in what way this set of vignettes measures patient-tailored risk strategies and improves quality of oral care. The lack of epidemiological data regarding dental caries and periodontal disease in The Netherlands hampers reliable estimates of various risk groups on a national level. As a result, cost-effectiveness research on ROEs is hardly to carry out. A plea for funding of national oral epidemiology research programmes is therefore justifiable.

Implications for practice

The observed variation in clinical ROE behaviour highlights the need for continuing education and quality improvement for GDPs, completed with patient information on risk aspects for oral disease resulting in consistent and shared decision-making. Self-assessment instruments on clinical performance, such as patient vignettes, could be applied for educational purposes for GDPs in peer groups as well as in dental practice teams.

To promote shared decision-making, efforts should be made to improve patient's knowledge about individual risk factors by means of improved communication skills for professionals, and (online) accessible, reliable information on innovations in preventive oral care delivery.

Competent members of the dental team, besides the GDP, could be held responsible for consecutive consultations and information and advice regarding specific risks for oral disease. However, a prerequisite for 'preventive' task delegation is to organise optimal teamwork in daily practice with as a consequence regular structural meetings and adherence to CPGs and treatment protocols. Selecting low-risk oral disease patients enables ROE task delegation for specified groups to co-workers within the dental team.

Lack of time, in general practice a frequently experienced management problem, prevents systematic recording of clinical and radiographic patient data. Most GDPs work with electronical patient records. Extensive efforts should be made to improve current software packages in general dental practice to more effective and practical data collection regarding risk management.
A dental practice assessment instrument developed to measure individual as well as team performance in daily practice could challenge dental professionals to improve day-to-day practice by implementing assessment outcomes into behaviour change. Recording of predefined risk levels enables to asses improvements in subgroups of patients in time. Furthermore, the assessment outcomes and improvements could be used to advertise oral care delivered by the dental team, facilitating patients to make decision based on reliable information.

Implications for health care policy

In oral health care in The Netherlands, organisations for structural quality improvement in general dental practice do not exist. An 'clinical excellence' institute, such as the National Institute of Clinical Excellence (NICE) in the United Kingdom, and 'Het Nederlands Huisartsen Genootschap (NHG)' for primary health care in The Netherlands, in oral care is highly needed, providing instruments and programmes to improve clinical performance (such as structural development of clinical practice guidelines and process quality indicators). Scientific and professional associations, as well as oral health stakeholders, should make an effort to arouse such a professional instutute, or seek cooperation with existing experienced national institutes in general health care.
A national health care policy should be promoted in which GDPs' guideline-adherent clinical ROE performance should economically be supported. The assessment of a patient-tailored risk strategy could be based on clinical performance process indicators.
While primary oral care has many unique features, it also shows similarities with specific domains of medical practice. For instance, lessons may be drawn from the implementation of cardio-vascular risk management in primary medical care to deal with multifactorial disease management in dental practice. Common risk factor approaches are promising strategies and underline the cooperation within various primary care settings. Finally, evaluation and practice-based research are crucial for guiding health policy, also in the domain of quality improvement in general dental practice.

Implications for dental education

Undergraduate dental education in principles of evidence-based health care and the implementation of quality instruments build on these principles, like guideline development and quality indicators, should be emphasised. The new dental school curriculum, resulting in 'general oral practitioners (GOP)' with extended scientific and medical competences, should predominantly focus on these principles. Furthermore, educational efforts should be made to implement patient-tailored risk management in dental teams with various professionals, starting early in undergraduate dental education.

This thesis elaborates various aspects of routine oral examination in general dental practice. The changing needs of patients, specifically concerning susceptible subgroups, should challenge professionals in primary oral care to reconsider standard practice routines. The results of the research conducted in this thesis, highlight the need for professional reorientation and instruments for guidance to improve oral care delivered to individuals, who are for the greater part highly motivated continuing to be regular attendees in general dental practice.

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Summary

Summary

The focus of this thesis is to explore opinions and preferences of general dental practitioners (GDPs) and patients concerning routine oral examinations (ROEs), to assess GDPs clinical behavior conducting ROEs tailored to recall intervals, to search for the evidence base, and to develop and implement instruments for improvement of ROEs in oral care for regular attending patients.

Chapter 1 explores differences in clinical behaviour (characteristics and opinions) of general dental practitioners (GDPs). A written questionnaire was sent in 2000 to a stratified sample of 610 dentists, of which 508 responded (83%). The study was conducted to get insight in professional opinions concerning routine oral examination (ROE), and the type of recall intervals (fixed or individualised) used. A fixed recall interval is the same period of time for all patients between successive ROEs, whereas an individualised recall interval varies among patients and is based on the assessment of the individual risk for disease onset or progression. We studied the influence of the decreasing prevalence of multifactorial oral diseases on recall decisions and to what extent GDPs, using either fixed or individual recall assignment between successive ROEs, differ in clinical behaviour.
Nearly equal numbers of GDPs applied fixed (51%) and individualised intervals (49%) between successive ROEs. GDPs applying fixed recalls also used fixed periods between successive bitewing radiographs prescription for all patients, and adhered more to the opinion that a fixed recall regime (every six months) should be re-introduced. GDPs applying individualised recalls required more time to conduct a ROE, partly because of a more extensive periodontal screening and were more in favour of the opinion that the ROE is 'an excellent instrument for effective, individualised oral care'.

Chapter 2 describes a questionnaire survey in which we aimed to explore decision-making behaviour of GDPs in performing ROEs with regard to content and frequency over a five-year period. A stratified sample consisted of 809 dentists and 475 (61%) were used for analysis. Data were compared with a cohort sample of participants collected in year 2000. Regarding the content of ROEs (type and number of diagnostic examinations performed), the mean number of specific diagnostic examinations carried out by all GDPs was 6.9 (SD = 1.7) of which 'diagnosis of caries', 'assessment of restorations' and 'oral hygiene' were assessed by all GDPs consistently. A shift towards individual recall policy was observed from 49 % in 2000 to 61.5% in 2005, whereas in contrast the frequency of BW prescription in both groups showed almost no change, which means 44% of the GDPs used fixed BW periods for all patients. Based on their orientation towards patients, professional technology, task delegation and business, individual assigning GDPs had a more patient oriented performance, while more technology oriented GDPs had a more fixed recall interval policy.

Chapter 3 reports on opinions of regular attending patients in general dental practice. Historically, six-monthly visits were fully covered for insured people by the Dutch sick fund. A health care reform in 1995 changed the six-monthly ROE-reimbursement into maximally once a year. By conducting this questionnaire survey in 2003, we aimed to determine patients' opinions about this policy change and assess their preferences regarding frequency and content of ROEs. Determinants of patient preferences, like patients' dental attitude, their subjective oral health and socio-demographic items were assessed. Seven dental practices in different parts of The Netherlands were selected and requested to administer a questionnaire to 125 patients. Eventually, 428 completed the questionnaire (48.9%). A majority of the patients (73%) reported that their ROE-frequency had not altered as a consequence of the change in policy in 1995. A substantial part of the patients (64%) reported to continue attending the dentist twice a year. Patients' evaluation of six monthly fixed ROEs was significantly more positive than their evaluation of flexible frequencies. Factors associated with a preference for fixed recalls were female gender, being more satisfied with one's teeth, less cynicism towards dental professionals and more motivated to maintain a good oral health.

Chapter 4 describes a prospective observational study assessing the performance and clinical management of GDPs in every day practice by means of clinical case self-recording. The GDP, immediately after conducting a ROE, recorded clinical data in a structured way on a registration form. Each GDP was asked to select on a random working day 8-10 consecutive scheduled ROE patients and to fill out a clinical case recording form for each patient. The form covered specific domains and items that are potentially part of ROE. The rationale for these domains was based on a rigorously national conducted consensus procedure (RAND-modified Delphi) on content and frequencies of ROEs. A total of 131 GDPs from The Data Station Project (DSP) of The Dutch Dental Association (NMT) completed the recording procedures. The contents assessed concerned patient characteristics, contents of ROE visit, diagnoses made and clinical behaviour in response to ROE findings. GDPs performed very consistently on ROE-domains like 'clinical examination', 'recall interval assessment' and 'time investment'. We found substantial variation in clinical behaviour between GDPs for specific ROE domains, in particular for the content 'patient history', and for clinical activities 'patient communication' and 'record keeping' aspects. Performance and clinical decisions made were more strongly associated with GDP characteristics than with patient characteristics. There was a strong tendency to assign six-monthly recall intervals, irrespective of the oral condition of patient. The overall mean time spent per ROE was 10.3 min (95% CI: 9.5-11.0).

In **Chapter 5**, we tried to identify patient-, GDP- and practice characteristics responsible for the observed substantial variation between GDPs in conducting ROEs. The study was based on clinical case recording of 1059 ROEs by 128 GDPs. A multilevel regression analysis was conducted in which 28 ROE aspects concerning oral health assessment- and clinical management domains were selected as dependant- and 6 patient characteristics and 7

GDP-characteristics as independent variables. Patients' age was the predominant predictor. Furthermore, patients' oral health compliance, the period that a patient was disease free and the risk for periodontal disease were the most salient predictors. A positive attitude to systematic periodontal screening showed to be a prominent GDP predictor. Also continuing professional development (peer groups, reading literature) and cooperation with peers in dental practice predicted significantly clinical behaviour. A patient-tailored surveillance approach showed to be not generally accepted in dental practice.

Chapter *6* describes a search for scientific evidence on the (cost)-effectiveness and risk assessment aspects of ROEs. Evidence-based practice refers to 'practice that integrates evidence, clinical expertise and patient preference'. The most used contemporary method to summarise scientific information on effectiveness of ROE items and recall intervals is a systematic review, preferably of randomised controlled studies. An attempt was made to explore most efficiently the available evidence electronically as well as by searching for evidence in handbooks and reference lists. Insufficient evidence exists either to support or reject the practice of encouraging patients to visit the dentist every six months for ROE, preventing any reliable conclusion for the determination of optimal recall intervals based on (cost)-effectiveness. The best available evidence-based predictor applicable in dental practice is previous disease experience. Individual differences in disease progression rates in patients as well as on surfaces in dental caries prevent precise bitewing frequency prescription.
Risk based screening for early detection of oral cancer may reduce morbidity and increase survival rates despite the lack of evidence which screening method is most beneficial.
Individual oral health education and advice showed to be beneficial to individual patients.
No scientific evidence exists that mass media programmes significantly influences oral health related outcomes.

Chapter *7* presents a systematic Cochrane review regarding the prophylactic removal of asymptomatic impacted third molars. Prudent decision-making, with adherence to specified indicators for removal may reduce the number of surgical procedures substantially. The search of the literature (electronically and by hand searching) focussed on randomised clinical trials. Only three randomised studies were identified, meeting the review selection criteria, of whom two were completed and one was ongoing. No reliable evidence was found to support or refute routine prophylactic removal of asymptomatic impacted wisdom teeth in adults. Regarding adolescents, there is some reliable evidence that suggests that removal of mandibular wisdom teeth does not prevent or reduce late lower incisor crowding. The important role of the GDP in the decision-making process conducting ROEs should be acknowledged.

Chapter *8* highlights the development of an online decision-support system of risk-based patient vignettes concerning ROEs designed as Content Management System (CMS). A patient vignette represents a defined patient age group whose risk factors for oral disease and clinical

and non clinical patient characteristics are for the greater part identical. Per vignette a risk level is provided with recommendations for the type and number of screening items, the frequency of bitewing radiographs and the assigned recall interval. The educational system was developed both for under- and postgraduate training, to provide guidance and assess clinical performance. A validated online procedure (RAND-modified Delphi) was conducted with two expert groups representing all relevant fields in dentistry. The development process consisted of the assessment by 31 experts of 27 ROE patients parents based on risk factor assessments. This eventually resulted in 19 patient vignettes covering all age categories and risk profiles of regular attending patients in general dental practice. The results were documented and used for the development of a clinical practice guideline (CPG) on ROEs. A pilot with 35 experienced GDPs was conducted to assess the appropriate use of the system for continuing professional development (CPD). It was assumed that risk-based patient vignettes regarding patient-tailored management of ROEs provide a potential instrument for CPD. When the CMS is useful for CPD it can also play a role in undergraduate computer-assisted learning and training in Dental Schools.

Chapter 9 presents the published research protocol for a cluster-randomised implementation study in general dental practice. The conductance of this multifaceted rather complex trial in general dentistry is innovative and prevailing knowledge is lacking. We considered an international, peer reviewed, assessment of the study design to be a preferable step before starting the trial in dental practice. The main objective was to describe study methods (recruitment of GDPs, inclusion-and exclusion criteria of patients and GDPs), intervention (planned interventions, randomisation and outcome measures, data collection, sample size, statistical analysis), economic evaluation (effectiveness, costs) and discuss emerging problems.

In **Chapter 10**, the impact of the provision of intensive peer group support to improve professional decision-making in daily practice is presented. The effects of multifaceted interventions were assessed in a cluster-randomised controlled trial in seven peer groups (IQual) of 51 GDPs, working in general dental practice. Information on GDPs clinical decisions was gathered by means of prospective recording of ROE encounters by GDPs themselves. Based on the primary- (recall interval) and secondary (bitewing frequency) outcome measures, adherence scores were calculated before and after the planned interventions. The interventions comprised successively online risk-based patient vignette training, dissemination of a CPG by mail, and an interactive peer group meeting for continuing professional development (CPD) with group feedback. Reminders (flow charts) were sent by mail four weeks after the meeting. Seven peer groups (51 GDPs) were randomised to one of the trial arms, 4 groups (27 GDPs) into the intervention- and 3 groups (24 GDPs) into the control arm. Three GDPs in the intervention arm were lost for follow up. For the primary outcome measure, 'recall interval assignment', in low-risk patients fairly low CPG adherence percentages were found (between 10.8% and 28.5%) before and after the intervention. Concerning the secondary outcome measure bitewing radiograph frequency, low CPG adherence percentages (between 17.1% and 41.8%) were found

before and after the intervention in high-risk patients. The intervention group improved slightly in assigning recalls in the low-risk patients (+8.0% versus –6.1% in the control group). Bitewing frequency prescription in high-risk patients showed substantially improvement in the control group (+24.1%), whereas in the intervention group performance change before and after the intervention was nearly found (-1.3%). Improvement of guideline-adherent recall decisions should be achieved mostly in low-risk patient groups and decisions concerning timing of bitewing radiographs in high-risk patient groups.

In the **general discussion** the main findings of this thesis are presented and discussed. The conclusions are categorised per section, i.e opinions on current practice, professional performance, the evidence base and instruments for improvement. Some relevant methodological issues are reviewed and finally the general discussion ends with recommendations for practice, research an dental education.

Based on the literature studies performed and the practice-based research conducted on assessing and improving ROEs for regular attendees, we suggest a stepwise patient-tailored risk ROE model to implement in general dental practice.

Samenvatting

(Summary in Dutch)

Samenvatting

Dit proefschrift beschrijft opinies en meningen van tandartsen en patiënten over het periodieke mondonderzoek (PMO), analyseert het klinische handelen van tandartsen bij de uitvoering PMO's in de algemene praktijk, presenteert een actueel overzicht van de bestaande wetenschappelijke literatuur, en geeft een aanzet tot de ontwikkeling en implementatie van instrumenten die de kwaliteit van het handelen tijdens de uitvoering van PMO's kunnen verbeteren.

In **Hoofdstuk 1** worden de verschillen beschreven in klinisch gedrag (kenmerken en meningen) van tandartsen in de algemene praktijk. In 2000 werd een vragenlijst verspreid onder een steekproef van 610 tandartsen, van wie 508 (83%) deelnamen aan de schriftelijke enquête. Dit onderzoek werd uitgevoerd om meer inzicht te krijgen in professionele opinies met betrekking tot het periodieke mondonderzoek (PMO) en de verschillen in type controletermijn die patiënten kregen toegewezen. Tandartsen hanteerden of een vaste controletermijn voor alle regelmatige bezoekers (meestal 6 maanden) of een flexibele controletermijn. Deze flexibele of individueel bepaalde termijn varieert per patiënt en wordt sterk beïnvloed door het individuele risico op mondziekten. De interesse ging uit naar de invloed van de sterk afgenomen prevalentie van mondziekten op de lengte van de controletermijn, alsmede in welke mate tandartsen daarin onderling verschillen en waardoor die verschillen in klinisch gedrag dan bepaald worden. Iets meer dan de helft (51%) van de tandartsen hanteert een vaste of standaard controletermijn voor alle patiënten terwijl de overigen gebruik maken van een individuele of flexibele termijn. Tandartsen die er voor kiezen vaste termijnen te hanteren voor alle patiënten, gebruiken ook vaker vaste frequenties voor het maken van bitewing röntgenfoto's. Deze tandartsen zijn voorstander van de herinvoering van de verplichte halfjaarlijkse gebitscontrole. Tandartsen die de controletermijn individueel bepalen, besteden meer tijd aan een PMO, zijn meer gericht op systematisch onderzoek van het parodontium en zien het PMO nadrukkelijker als een 'uitstekend instrument voor effectieve, individuele mondzorg'.

Hoofdstuk 2 beschrijft het klinisch gedrag van tandartsen met betrekking tot de bepaling van de controletermijnen en frequentie van bitewing röntgenfoto's, over een periode van 5 jaar. Een schriftelijke vragenlijst werd verspreid onder een steekproef van 809 tandartsen, werkzaam in de algemene praktijk, waarvan er 475 (61%) werden gebruikt voor de analyse. De uitkomsten werden vergeleken met een cohort tandartsen dat in 2000 de vragenlijst had ingevuld. Met betrekking tot de inhoud van het PMO (type en aantal deelonderzoeken) bleek dat gemiddeld per tandarts 6.9 (SD = 1.7) deelonderzoeken werden uitgevoerd. Cariës diagnostiek, de beoordeling van restauraties en de mondhygiëne vormden altijd onderdeel van het PMO.
Het aantal tandartsen dat de controletermijn individueel bepaalde was toegenomen van 49% in 2000 tot 61.5% in 2005. In tegenstelling daarmee trad geen verschuiving op in de standaard frequentie waarmee bitewing röntgenfoto's voor alle patiënten werden vervaardigd. Tussen 2000 en 2005, bleef dit percentage (44%) tandartsen nagenoeg gelijk. Bezien vanuit de

professionele gerichtheid van tandartsen (vakgericht, patiëntgericht, taakverdelingsgericht en bedrijfsmatig gericht) bleek dat tandartsen die individuele termijnen hanteerden een sterkere patiëntgerichtheid vertoonden, terwijl zorgverleners die voor vaste termijnen opteerden, een sterkere vaktechnische gerichtheid aan de dag legden.

In **Hoofdstuk 3** worden de voorkeuren van regelmatige bezoekers voor de frequentie van een periodiek mondonderzoek beschreven. Historisch gezien werd van iedere ziekenfonds verzekerde verwacht dat deze twee keer per jaar de tandarts bezocht voor een mondonderzoek, om recht te doen gelden op vergoeding vanuit de verzekering. In 1995, werden deze aanspraken gereduceerd tot maximaal één PMO per jaar. De gehanteerde schriftelijke vragenlijst inventariseert opinies en voorkeuren van regelmatige bezoekers van tandartspraktijken. Patiëntkenmerken zoals tandheelkundige attitude, subjectieve beleving van mondgezondheid en sociaal demografische kenmerken werden beoordeeld. In 7 tandartspraktijken verspreid over Nederland werden per praktijk 125 vragenlijsten uitgezet. 428 regelmatige bezoekers vulden een vragenlijst in (48.9%). Het merendeel van de regelmatig bezoekers (73%) gaf aan dat de bezoekfrequentie niet was beïnvloed door de stelselwijziging van 1995. Een aanzienlijke groep (64%) gaf aan de gewoonte van tweejaarlijkse PMO's te blijven voortzetten, daarmee een voorkeur uitsprekend voor vaste termijnen. Een sterkere voorkeur voor vaste halfjaarlijkse controle bezoeken werd gevonden bij vrouwen, bezoekers die tevreden waren over hun mondgezondheid, bezoekers die een minder cynische houding hebben ten opzichte van mondzorgverleners en regelmatige bezoekers die gemotiveerd zijn om de mondgezondheid optimaal te houden.

In **Hoofdstuk 4** wordt een observationele studie beschreven waarin beoordeeld werd hoe tandartsen in de klinische praktijk omgaan met verschillende patiënten die voor een PMO komen. Zelfregistratie werd gehanteerd als methode om gegevens te verzamelen. Deze methode bestond uit het laten vastleggen door de tandarts van handelingen, overwegingen en gevolgtrekkingen bij 8-10 opeenvolgende patiënten die op een willekeurige dag een afspraak voor een PMO hadden gemaakt. Het vastleggen van gegevens vond onmiddellijk na het uitvoeren van het PMO plaats op een speciaal ontwikkeld registratieformulier. Het formulier was zodanig opgebouwd dat specifieke domeinen en items, voortgekomen uit een landelijke RAND gemodificeerde Delphi consensusprocedure met betrekking tot inhoud en frequentie van PMO, aan bod kwamen. In totaal 131 tandartsen, gerekruteerd uit de Peilstations van de Nederlandse Maatschappij tot bevordering der Tandheelkunde (NMT), namen deel aan deze studie. Aspecten die werden beoordeeld waren patiëntkenmerken uit het verleden, de inhoud van het klinisch onderzoek, de gestelde diagnose en het klinisch handelen. In de praktijk vertoonden tandartsen sterk overeenkomend gedrag met betrekking tot het aantal uit te voeren items van klinisch onderzoek, de bestede tijd en de lengte van de controletermijn. Er werd een substantiële variatie vastgesteld in het klinisch gedrag met betrekking tot het afnemen van de anamnese, het geven van voorlichting en advies, en het vastleggen van klinische en niet klinische

gegevens in het patiëntdossier. Het klinisch handelen en beslissen leken sterk beïnvloed te worden door tandartskenmerken. Het hanteren van zes maandelijkse controletermijnen bleek algemeen gebruik in de praktijk en leek geen relatie te hebben met verschillen in individuele mondgezondheid van regelmatige tandartsbezoekers. De gemiddelde tijd per PMO besteed bedroeg 10.3 minuten (95% CI: 9.5-11.0).

In **Hoofdstuk 5** wordt beschreven welke patiënt-, tandarts- en praktijkfactoren verantwoordelijk zijn voor de gevonden verschillen in klinisch handelen en beslissen tijdens het uitvoeren van PMO's. De studie werd uitgevoerd door middel van zelfregistratie direct na uitvoering van het PMO. In totaal werden 1059 PMO's door 128 tandartsen vastgelegd op speciale registratieformulieren. Er werd een regressie analyse op verschillende niveaus uitgevoerd met de 28 PMO-items als afhankelijke variabelen uit de domeinen 'historie', 'anamnese', 'klinisch onderzoek', 'aanvullend onderzoek', 'communicatie' en het 'vastleggen van gegevens' en 6 patiënt- en 7 tandartskenmerken als onafhankelijke variabelen. De meest bepalende patiëntfactor was de leeftijd. Daarnaast bleken het gebitsbewustzijn, de periode vrij van mondziekte, en het risico op parodontale ziekteverschijnselen patiëntfactoren te zijn die verantwoordelijk waren voor verschillen in klinisch handelen van tandartsen. Een prominent verklarend tandartskenmerk bleek het systematisch onderzoek van parodontale ziekteverschijnselen te zijn. Het lezen van wetenschappelijke- en vakliteratuur, deelname aan studiegroepen en samenwerking met collega's in één praktijk, bleken voorspellers voor klinisch handelen tijdens het PMO. Een op het risico van de individuele bezoeker afgestemd PMO met als resultaat een individueel bepaalde controletermijn bleek in de algemene praktijk niet algemeen geaccepteerd.

In **Hoofdstuk 6** wordt beschreven op welke wijze het wetenschappelijke bewijs met betrekking tot de (kosten)-effectiviteit van het PMO en risico gerelateerde aspecten voor onderdelen van het PMO is uitgevoerd. Op bewijs gebaseerd klinisch handelen in de praktijk is gericht op het integreren van beschikbaar wetenschappelijk bewijs, klinische ervaring en de voorkeuren van patiënten. De meest optimale methodiek om wetenschappelijke informatie over PMO's en controletermijnen te inventariseren is het systematisch literatuuroverzicht, bij voorkeur bestaande uit gerandomiseerde studies. Er werd gestructureerd en systematisch gezocht in elektronische databases, handboeken en referentielijsten. Op wetenschappelijke gronden is geen onderbouwing te vinden om bij alle patiënten iedere zes maanden een mondonderzoek uit te voeren. Als gevolg daarvan kunnen betrouwbare uitspraken over optimale controletermijnen gebaseerd op kosteneffectiviteit niet worden gedaan. De beste voorspeller in de praktijk om op basis van het individueel risico een controletermijn te bepalen is vooralsnog de al dan niet reeds doorgemaakte mondziekte(n). Omdat individuele verschillen in de snelheid waarmee cariës zich uitbreidt, zowel op patiënt- als elementniveau aanzienlijk kunnen zijn, wordt de betrouwbaarheid om een optimale individuele frequentie van bitewing röntgenfoto's te bepalen beperkt. Vroegtijdige opsporing van mondkanker op basis van een individuele risicoanalyse

tijdens PMO's kan de ziektelast onder de bevolking beperken en overlevingskansen vergroten, ondanks het ontbreken van het wetenschappelijke bewijs voor de meest optimale methode. Individueel advies en voorlichting tijdens het PMO (instructie mondhygiëne en fluoridenadvies) bleken effectief te kunnen zijn in het terugdringen van de hoeveelheid tandplaque op de korte termijn. Er is geen wetenschappelijk bewijs voorhanden dat voorlichting op basis van grote publiekscampagnes een positieve invloed heeft op de mondgezondheid.

In **Hoofdstuk 7** wordt een Cochrane systematisch literatuuroverzicht beschreven met betrekking tot de profylactische verwijdering van klachtenvrije geïmpacteerde verstandskiezen in de onderkaak, een veelvuldig uitgevoerde chirurgische ingreep bij (jong) volwassenen als gevolg van PMO's. Cochrane systematische literatuuroverzichten beperken zich tot een minutieuze zoektocht naar gerandomiseerde interventie studies. Uiteindelijk werden drie gerandomiseerde studies (RCT's) geïdentificeerd, die aan de beschreven inclusiecriteria voldeden. Het systematisch preventief verwijderen van klachtenvrije, geïmpacteerde verstandskiezen (derde molaren) bij jong volwassenen kan op basis van wetenschappelijk bewijs niet worden aanbevolen of afgeraden. Individuele, op risico gebaseerde besluitvorming, rekening houdend met specifieke indicaties voor chirurgische verwijdering, kan een aanzienlijke bijdrage leveren aan het beperken van het aantal chirurgische ingrepen. De relevante rol van de algemeen practicus bij deze klinische besluitvorming tijdens de uitvoering van het PMO wordt onderstreept, evenals de voorkeur van de patiënt. Er zijn wetenschappelijke aanwijzingen dat het preventief verwijderen van verstandkiezen in de onderkaak bij adolescenten het ontstaan van crowding in het onderfront noch voorkomt noch beperkt.

De ontwikkeling van een elektronisch 'decision-support' systeem voor tandartsen in de algemene praktijk, met als inhoud een set van 19 representatieve patiënt risicoprofielen, wordt in **Hoofdstuk 8** beschreven. Een risicoprofiel vertegenwoordigt een groep patiënten die wat betreft leeftijd, risicofactoren/indicatoren en specifieke kenmerken met elkaar overeenkomen en op basis waarvan uitspraken gedaan kunnen worden over het gewenste beleid. Per risicoprofiel worden aanbevelingen gegeven over risicoclassificatie, type en aantal deelonderzoeken, de frequentie van bitewing röntgenopnamen en de lengte van de controletermijn. Het doel is om tandartsen in de besluitvorming te ondersteunen en hen inzicht te geven in behandelbeslissingen per risicoprofiel door individuele beslissingen te spiegelen aan de oordelen van experts. Deze expert oordelen werden geïnventariseerd door middel van een gevalideerde RAND-Delphi-procedure met twee expertgroepen (0 tot 18 jaar; 18 jaar en ouder) als onderdeel van een gestructureerde procedure voor de ontwikkeling van een PMO klinische praktijkrichtlijn. Het opsporen van de belangrijkste risicofactoren/indicatoren bij 27 verschillende op basis van risico geselecteerde PMO-patiënten vormde het uitgangspunt. Via drie consensusrondes werden uiteindelijk 11 risicoprofielen voor volwassenen en 8 risicoprofielen voor jeugdigen ontwikkeld. In een pilot met 35 ervaren tandartsen, die ieder 8 risicoprofielen beoordeelden, werd gekeken in hoeverre het CMS aan de doelstellingen

tegemoet kwam. Significante verschillen tussen expert oordelen en tandarts beslissingen traden vooral op in de lengte van de controletermijn bij laag risico patiënten en het voorschrijven van bitewing röntgenfoto's in hoog risico groepen. Een voorlopige conclusie van deze studie was dat een set van representatieve patiënt risicoprofielen een potentieel instrument vormt voor aanvullende scholing met betrekking tot individueel risicomanagement voor tandartsen en studenten tandheelkunde bij uitvoering van PMO's, mits het gebruik ervan wordt uitgevoerd in combinatie met training en terugkoppeling.

In **Hoofdstuk 9** wordt een onderzoeksprotocol beschreven voor een gerandomiseerd gecontroleerd experiment in de algemene praktijk. Het uitvoeren van een clustergerandomiseerde trial met meerdere uiteenlopende implementatiemethoden voor de ontwikkelde PMO-richtlijn. in tandartspraktijken is complex en innovatief. Recente kennis bestaat alleen uit ervaringen vanuit de medische (eerstelijns) zorgverlening. Het onderzoeksprotocol werd voorgelegd aan internationale experts op het onderzoeksterrein van implementatie van innovaties met als doel de beschreven methoden (werving tandartsen, inclusie- en exclusie criteria voor patiënten en professionals), geplande interventies (randomisatie, uitkomstmaten, verzameling van gegevens, omvang groep, statische analyses) en economische evaluatie voor uitvoering van de trial te toetsen. Dit leidde uiteindelijk tot publicatie van het protocol.

De effecten van intensieve begeleiding van IQual groepen in een implementatie-experiment om de klinische beslissingen met betrekking tot het PMO in de algemene praktijk te verbeteren worden beschreven in **Hoofdstuk 10**. In een cluster gerandomiseerd experiment werden zeven studiegroepen met 51 tandartsen gedurende 9 maanden in de trial opgenomen. Deze zeven groepen werden gerandomiseerd en ondergebracht in een van de twee armen, 4 groepen (27 tandartsen) in de interventiearm en 3 groepen (24 tandartsen) in de controlearm. Beide groepen tandartsen ontvingen een verschillende klinische richtlijn, en dienden als elkaars controlegroep. Informatie over klinisch gedrag van tandartsen bij de uitvoering van het PMO, gedurende de duur van de trial, werd verzameld met behulp van zelfregistratieformulieren in de praktijk. Uitgaande van de primaire (controletermijn) en secundaire (bitewing frequentie, preventief interventies) uitkomstmaten werden percentages richtlijnconforme beslissingen op basis van de registraties voor en na de geplande interventies berekend. De interventies omvatten respectievelijk online training in klinische risicoprofielen, disseminatie van de betreffende klinische praktijkrichtlijn per post, een scholingsavond op locatie met interactieve terugkoppeling van online profielscores en het toesturen van een reminder met uitgewerkte beslisdiagrammen. Met betrekking tot de bepaling van de controletermijn bij laag risico patiënten werden in beide groepen lage percentages richtlijnconforme beslissingen gevonden (tussen 10,8% en 28,5 %). Vergelijkbare lage percentages richtlijnconforme beslissingen werden ook waargenomen bij hoog risico patiënten met betrekking tot het maken van bitewing röntgenopnamen (tussen 17,1% en 41,8%). De bepaling van de controletermijn voor en na de

interventies bij laag risico patiënten in de interventiegroep verbeterde met +8.0% significant (p=0.00), terwijl in de controlegroep een afname van -6.1% richtlijnconforme beslissingen werd waargenomen. Verbetering van richtlijnconforme beslissingen bij de uitvoering van PMO's kan vooral worden bereikt bij de controletermijn bepaling bij laag risicogroepen alsmede bij de frequentie van het maken van bitewing röntgenopnamen bij patiënten met een hoog risico.

In de afsluitende **algemene discussie** worden de belangrijkste uitkomsten van de uitgevoerde studies per sectie samengevat en besproken. Tevens komen een aantal methodologische overwegingen aan de orde en er worden aanbevelingen gegeven voor verder onderzoek, klinische praktijk en het tandheelkundig onderwijs.
Op basis van de literatuurstudies en de uitgevoerde studies in tandartspraktijken, wordt een voorstel gedaan om met een stapsgewijs risicomodel de uitvoering van periodieke mondonderzoeken beter af te stemmen op de inviduele mondgezondheid van regelmatige tandartsbezoekers.

Appendices

Appendix 1 ZELFREGISTRATIE FORMULIER

Periodiek Mondonderzoek (PMO)

Instructie: *De vragen s.v.p. beantwoorden door het antwoord van uw keuze te omcirkelen. Heeft u zich een keer vergist, streep dan het verkeerde antwoord door en geef als nog het bedoel de antwoord. Bij enkele vragen zijn geen antwoordmogelijkheden voorgegeven, maar wordt u verzocht zelf een antwoord of toelichting op te schrijven.*

A Gegevens over de patiënt (voorafgaand aan het PMO in te vullen door tandartsassistent)

1	*Geslacht patiënt*	man	vrouw
2	*Geboortejaar patiënt*	. . . . .	
3	*Hoe vaak is de patiënt sinds 1 januari 2000 voor een PMO in de praktijk geweest?*	in 2000: . . . . . keer n 2001: . . . . . keer n 2002: . . . . . keer n 2003: . . . . . keer n 2004: . . . . . keer	
4	*Wanneer is het laatste* periodiek mondonderzoek gedaan?*	. . . (maand) 20 . . . . (jaar)	n.v.t.
5	*Wanneer zijn de laatste* bite-wing röntgenopnamen gemaakt?*	. . . (maand) 20 . . . . (jaar)	n.v.t.
6a	*Wanneer is de ASA-score voor het laatst* bepaald?*	. . . (maand) 20 . . . . (jaar)	n.v.t.
6b	*Wat was toen die ASA-score?*	. . . . .	
7a	*Wanneer is de DPSI-score voor het laatst* bepaald?*	. . . (maand) 20 . . . . (jaar)	n.v.t.
7b	*Wat was toen de maximale score?*	0 1 2 3- 3+ 4	
8a	*Wanneer heeft de laatste* parodontale behandeling** plaatsgevonden?*	. . . (maand) 20 . . . . (jaar)	n.v.t.
8b	*Wat was de diagnose voor deze parodontale behandeling?*		
9	*Wanneer is de laatste* restauratie gelegd als gevolg van cariës?*	. . . (maand) 20 . . . . (jaar)	n.v.t.
10	*Is er sprake van ontbrekende elementen door vroegtijdige extractie als gevolg van cariës en/of parodontitis?*	ja, element(en):	
		nee	
11	*Hoe groot is het totaal aantal gerestaureerde elementen?*	. . . . .	

* Het laatst(e) wordt hier bedoeld de laatste keer voorafgaand aan het dit PMO.

** Onder parodontale behandeling worden hier uitsluitend die diagnostische en therapeutische handelingen bedoeld die onder de T-codes van de UFT-lijst zijn beschreven.

B Evaluatie mondgezondheid tijdens dit PMO (in te vullen door tandarts)

1	*Heeft u zich bij aanvang van dit PMO een beeld gevormd van het tandheelkundig risico op basis van de historie?*	ja		nee	
2	*Hoe schat u het gebitsbewustzijn* in?*	goed	redelijk	slecht	
3a	*Heeft u gevraagd naar aanwezige klachten?*	ja		nee	
3b	*Zo ja, wat was de aard van die klacht?*				
4	*Heeft u vragen gesteld ter actualisering van de anamnese?*				
	a m.b.t. medische aspecten (geneesmiddelen, algemene gezondheid)	ja		nee	
	b m.b.t. sociale aspecten (voeding, roken, alcohol)	ja		nee	
	c m.b.t. tandheelkundige aspecten (pijn, ongemak, esthetiek, functie)	ja		nee	
5	*Welke klinische waarnemingen (d.m.v. visuele inspectie) heeft u uitgevoerd en wat waren de bevindingen?*				
	a cariës	aanwezig	twijfel	afwezig	niet bekeken
	b gingivitis	aanwezig	twijfel	afwezig	niet bekeken
	c parodontitis	aanwezig	twijfel	afwezig	niet bekeken
	d beoordeling restauraties	aanwezig	twijfel	afwezig	niet bekeken
	e slijmvliesafwijkingen	aanwezig	twijfel	afwezig	niet bekeken
	f groei- en gebitsontwikkeling	aanwezig	twijfel	afwezig	niet bekeken
	h anders, namelijk: . . .	aanwezig	twijfel	afwezig	niet bekeken
6	*Welke aanvullende klinische handelingen heeft u (of een van uw medewerkers) tijdens het PMO verricht?*				
	a maken van bite-wing röntgenopnamen	ja		nee	
	b polijsten/beperkt tandsteen verwijderen	ja		nee	
	c fluoride appliceren	ja		nee	
	d anders, namelijk: . . .	ja		nee	

* Onderkend belang bij de patiënt van een goede zelfzorg en het behoud van een stabiele mondgezondheid

C Communicatie met patiënt (in te vullen door tandarts)

1	*Heeft u uw bevindingen met de patiënt besproken?*	ja	nee
2	*Over welke onderwerpen heeft u (of een van uw medewerkers) aanvullend advies gegeven?*		
	a vervolgbehandeling	ja	nee
	b verwijzing naar tandartsspecialist	ja	nee
	c fluoridengebruik	ja	nee
	d voedingsadvies	ja	nee
	e mondhygiëne/plaquebeheersing	ja	nee
	f schriftelijk voorlichtingsmateriaal verstrekt	ja	nee
	g anders, namelijk: . . .	ja	nee

D Verslaglegging in het patiëntendossier (in te vullen door tandarts)

1	*Heeft u het patiëntendossier geactualiseerd* na dit PMO?*	ja	nee
2	*Zo ja, over welke onderwerpen heeft informatie vastgelegd c.q. laten vastleggen?*		
	a bevindingen röntgenopnamen	ja	nee
	b initiële cariëslaesie	ja	nee
	c hoeveelheid en/of locatie tandplaque	ja	nee
	d mate en/of locatie tandvleesbloeding	ja	nee
	e pockets	ja	nee
	f wensen van de patiënt	ja	nee
	g orthodontie	ja	nee
	*h mate van gebitsbewustzijn***	ja	nee
	i anders, namelijk: . . .	ja	nee

* Het actualiseren wordt bedoeld het vastleggen van informatie naar aanleiding van het PMO met uitzondering van de gedeclareerde UPT-behandelcodes.

** Bedoeld wordt het onderkend belang bij de patiënt van een goede zelfzorg en het behoud van een stabiele mondgezondheid.

E Vervolgbehandeling (in te vullen door tandarts)

1	*Heeft u een afspraak gemaakt voor vervolgbehandeling(en) en zo ja, voor welk type behandeling(en)?*	
	ja, voor . . .	nee

F Bepaling controletermijn (in te vullen door tandarts)

1	*Hoe schat u, in vergelijking met het vorige PMO, het tandheelkundig risico in op het ontstaan van mondziekten op korte termijn na uitvoering van dit PMO én de eventuele vervolgbehandeling(en)?*		
	risico ongewijzigd	risico toegenomen door . . .	risico afgenomen door . . .
2	*Kunt u op onderstaande schaal van 0% tot en met 100% aankruizen hoe groot u de kans inschat dat er binnen een jaar cariës is ontstaan of indien al aanwezig, in ernst (progressie) is toegenomen? **		
	0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%		
3	*Kunt u op onderstaande schaal van 0% tot en met 100% aankruizen hoe groot u de kans inschat dat er binnen een jaar parodontitis is ontstaan of indien al aanwezig, in ernst (progressie) is toegenomen? **		
	0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%		
4	*Heeft u de controletermijn voor het volgende PMO gehandhaafd of gewijzigd door veranderd tandheelkundig risico?*		
	controletermijn gehandhaafd op: . . . . . maanden	controletermijn gewijzigd, nu bepaald op: . . . . . maanden	
5	*Heeft u de patiënt laten meebeslissen over de bepaling van de controletermijn en zo ja, was er sprake van verschil van inzicht over de duur van de controletermijn?*		
	niet laten meebeslissen	wel laten meebeslissen en geen verschil van inzicht	wel laten meebeslissen en verschil van inzicht, namelijk: . . .

* Gegeven de omstandigheid dat er geen grote veranderingen optreden in het tandheelkundig gedrag en/of de mondgezondheid.

G Tijdsinvestering en declaratie (in te vullen door tandarts)

1a	*Hoeveel tijd heeft u in totaal besteed aan het PMO?*	. . . . . minuten
1b	*Kunt u bij benadering aangeven hoeveel tijd u heeft besteed aan onderstaande onderdelen van het PMO?*	
	a mondonderzoek	. . . . . minuten
	b beoordeling röntgenopnamen	. . . . . minuten
	c verslaglegging patiëntendossier	. . . . . minuten
	d communicatie met patiënt	. . . . . minuten
	e maken verwijsbrief	. . . . . minuten
2	*Welke verrichtingencodes heeft u met betrekking tot het PTC gedeclareerd?*	
	a C-codes: . . .	
	b X-codes: . . .	
	c M-codes: . . .	
	d andere codes: . . .	

Appendix 2. Registratieformulier trial en Risicoscorelijst

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Registratieformulier klinische trial PMO 2007

Formulier ingevuld door: ☐ tandarts ☐ mondhygiënist Tandarts: 208 - 1

Historie		Registratie (v=verleden)
1. Leeftijd	☐☐☐ jaar	
2. Patiëntdossiernummmer	☐☐☐☐☐☐ - ☐☐	
3. Geslacht	☐ vrouw ☐ man	
4. Gave dentitie (*1)	☐ ja ☐ nee	
5. Gebitsbewustzijn/coöperatie (*2/*3)	☐ 0 ☐ 1 ☐ 2	☐ v
6. Tijdstip laatste setje van 2 BW-opnamen	☐☐ maand ☐☐☐☐ jaar ☐ n.v.t.	☐ v
7. Eén na laatste setje van 2 BW-opnamen	☐☐ maand ☐☐☐☐ jaar ☐ n.v.t.	☐ v
8. Gebitsontwikkeling	☐ melk ☐ wissel ☐ blijvend	☐ v
9. Derde molaren, klinisch (>18 jaar)	18:☐ aanwezig 28:☐ aanwezig 38:☐ aanwezig 48:☐ aanwezig ☐ afwezig ☐ afwezig ☐ afwezig ☐ afwezig ☐ onbekend ☐ onbekend ☐ onbekend ☐ onbekend	☐ v
10. Totaal aantal PMO's laatste 5 jaar	☐☐ keer	☐ v
Risico na vorig mondonderzoek		
11. - Cariës	☐ hoog ☐ verhoogd ☐ verlaagd ☐ laag	☐ v
12. - Parodontitis (DPSI>2)	☐ hoog ☐ verhoogd ☐ verlaagd ☐ laag	☐ v
13. - Slijmvliezen	☐ hoog ☐ verhoogd ☐ verlaagd ☐ laag	☐ v
14. Laatste goadviseerde termijn (mnd)	☐☐ maanden	☐ v

Waarnemingen		Registratie (v=verleden h=heden)
15. Klachten	☐ ja ☐ nee	☐ v ☐ h
16. DPSI-score (hoogste score)	☐ 0 ☐ 1 ☐ 2 ☐ 3- ☐ 3+ ☐ 4 ☐ n.v.t.	☐ v ☐ h
17. ASA-score	☐ I ☐ II ☐ III ☐ IV ☐ onbekend ☐ n.v.t.	☐ v ☐ h
18. Rookgewoonte	☐ ja ☐ nee	☐ v ☐ h
19. Voeding (koolhydraatarm / -rijk)	☐ gunstig ☐ ongunstig	☐ v ☐ h
20. Drinkgewoonte (alcohol)	☐ weinig < 2 p.d. ☐ matig 2-4 p.d. ☐ veel > 4 p.d. ☐ onbekend	☐ v ☐ h
21. Cariës (*3)	☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ v ☐ h
22. Parodontium (*3)	☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ v ☐ h
23. Slijmvliezen	☐ bijzonderheden ☐ geen bijzonderheden	☐ v ☐ h

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24. Gebitsontwikkeling, 0-18 jaar (*3)	☐ 0 ☐ 1 ☐ 2 ☐ 3	☐ v ☐ h
25. Hoeveelheid tandplaque	☐ groot (>40%) ☐ gemiddeld ☐ beperkt (<10%)	☐ v ☐ h
26. Derde molaren OK(48) 17-30 jaar -Situatie: (*3)	☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ onbekend	☐ v ☐ h
-Indien impactie:positie in de kaak:	☐ ☐ ☐ ☐	☐ v ☐ h
27. Derde molaren OK(38) 17-30 jaar -Situatie: (*3)	☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ onbekend	☐ v ☐ h
-Indien impactie:positie in de kaak:	☐ ☐ ☐ ☐	☐ v ☐ h
28. Planning eerstvolgende BW-opnamen	☐☐ maand ☐☐☐☐ jaar	☐ v ☐ h
29. Tandsteen verwijdering tijdens dit PMO	☐ ja, M50 ☐ ja, M55 ☐ nee ☐ ja, M59 ☐ ja, andere code, nl: _ _ _ _	☐ v ☐ h
30. Fluoridengebruik patiënt	☐ optimaal ☐ suboptmaal ☐ geen	☐ v ☐ h
31. Aanslag / polijsten tijdens dit PMO	☐ ja ☐ nee	☐ v ☐ h

Beleid		Registratie (v=heden)
Inschatting huidig risico		
32. - Cariës	☐ hoog ☐ verhoogd ☐ verlaagd ☐ laag	☐ h
33. - Parodontitis (DPSI>2)	☐ hoog ☐ verhoogd ☐ verlaagd ☐ laag	☐ h
34. - Slijmvliezen	☐ hoog ☐ verhoogd ☐ verlaagd ☐ laag	☐ h
35. - Ontwikkeling derde molaren OK 17-30 jaar	☐ monitoren ☐ verwijderen ☐ retentie ☐ n.v.t.	☐ h
36. Soort vervolgbehandeling (*4) *(meer antwoorden mogel.jk)*	☐ preventie ☐ curatie ☐ n.v.t.	☐ h
37. Voorlichting / advies tijdens PMO	☐ ja , over: _ _ _ _ _ _ _ _ _ _ _ _ ☐ nee _ _ _ _ _ _ _ _ _ _ _ _	☐ h
38. Verwijzing naar mondhygiënist/prev.ass./specialist	☐ ja , voor: _ _ _ _ _ _ _ _ _ _ _ _ ☐ nee _ _ _ _ _ _ _ _ _ _ _ _	☐ h
39. Belangrijkste risicofactoren n.a.v. dit PMO	1 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _	☐ h
	2 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _	☐ h
	3 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _	☐ h
	☐ geen risicofactoren	
40. Termijn bepaald in overleg met patiënt	☐ ja ☐ nee	☐ h
41. Termijn bepaald op (mnd)	☐☐ maanden *(eventueel na afloop vervolgbehandeling)*	☐ h
Hoe lang duurde het invullen van deze lijst?	☐☐ minuten	

(*1) geen aanwezige ziekte(n) nu en in het verleden, geen restauratie(s), sealants wel of niet aanwezig.
(*2) het inzicht van de patiënt van het nut van goede zelfzorg.
(*3) zie scorelijst bij registratieformulier.
(*4) niet tijdens dit PMO

APPENDIX 2 RISICOSCORELIJST

Scorelijst t.b.v. registratieformulier klinische trial PMO 2007

	Gebitsbewustzijn / coöperatie score .
0	Goede zelfzorg en voldoende begrip belang stabiele mondgezondheid, laatste 5 jaar 1-2 keer PMO/jr
1	Matige en wisselende zelfzorg , begrip belang mondgezondheid beperkt, laatste 5 jaar 1-2 keer PMO/jr
2	Uitvoering zelfzorg onvoldoende,weinig begrip van belang mondgezondheid, laatste 5 jaar onregelmatig PMO(< 1/jr)
	Cariës score *er wordt hierbij een onderscheid gemaakt tussen het begrip laesie en cavitatie*
0	Geen cariës en geen restauraties in het verleden
1	Afgelopen 4-5 jaar geen nieuwe gecaviteerde laesies
2	Afgelopen 2-3 jaar geen nieuwe gecaviteerde laesies
3	Afgelopen 2-3 jaar slechts één gecaviteerde laesie, geen recente restauraties wegens cariës, maar een of meer glazuurlaesies per jaar
4	Afgelopen 2-3 jaar een toename van 2 of meer nieuwe gecaviteerde laesies per jaar
	Parodontium score
0	Geen parodontale ziekteverschijnselen en geen uitgebreide parodontale therapie (IB) in verleden, geen of zeer weinig tandplaque
1	Tandvleesbloeding na sonderen bij papillen(>4 papillen) met duidelijk aanwezige tandplaque, tandsteen onderfro
2	Tandvleesbloeding na sonderen, tandsteenvorming supra-gingivaal meer dan 2 kwadranten
3	Meerdere pockets met of zonder aanhechtingsverlies >4mm
4	Gegeneraliseerd aanhechtingsverlies,pockets > 6mm, ernstig verlies van steunweefsel, furcatie problemen, mobili
	Gebitsontwikkeling score, 0 – 18 jaar
0	Geen ontwikkelingsproblemen
1	Problemen te verwachten of in verleden doorgemaakt of afbehandeld
2	Tooth size discrepancy (TSD) op korte termijn te verwachten
3	TSD vastgesteld, monitoren groei, nu actieve behandeling
	Derde molaren onderkaak score, 17-30 jaar
0	Derde molaren doorgebroken en functioneel
1	Derde molaren onderkaak verwijderd /niet aangelegd
2	Derde molaren onderkaak volledig mucosaal geïmpacteerd
3	Derde molaren onderkaak partieel benig of mucosaal geïmpacteerd
4	Derde molaren onderkaak volledig benig geïmpacteerd

1

Publications

Publication list

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Het is allemaal begonnen met Fons Plasschaert, Richard Grol en Emiel Verdonschot die mij in 2003 het vertrouwen schonken om deze onderzoeksuitdaging aan te gaan. Mijn professionele blad was niet geheel onbeschreven: de voorafgaande vijf jaar was ik actief geweest als projectgroeplid tijdens het onderzoek naar methoden voor klinische praktijkrichtlijnen. Maar toch, het door hen geschonken vertrouwen om als 'senior' junioronderzoeker dit onderzoeksproject uit te voeren heeft me de vleugels voor een vliegende start gegeven. Gedurende de gehele periode van vijf jaar is die bezieling de smeerolie gebleven van mijn onderzoeksmotor. **Fons Plasschaert** heeft daarbij onmiskenbaar zijn organisatorische kwaliteiten ingebracht met als gevolg een gestroomlijnd verloop. Niet door te controleren, maar vooral doelgericht te stimuleren met respect voor eigen wijsheid. Fons, jouw voortdurende belangstelling voor de dagelijkse gang van zaken evenals je bereidheid om in te springen waar nodig, vormden de bouwstenen voor het succesvolle verloop. Dat schiep een werkomgeving waar ik me goed bij voelde! Je emeritaat in 2006 was geen enkele belemmering om met groot enthousiasme de voortgang te blijven stimuleren. Exemplarisch zijn de lange autoritten door het hele land samen met jou en Wil van der Sanden voor de scholing aan IQual tandartsen, vaak tot in de late avonduren! De periode die nu afgesloten wordt is voor mij niet alleen leerzaam geweest, het is ook een dierbare tijd geworden. En dat niet in het minst, doordat onze gesprekken niet beperkt bleven tot de uit te voeren onderzoeksverplichtingen.
Mijn andere promotor, **Richard Grol** is van onschatbare waarde geweest voor de realisatie van dit proefschrift. Richard, jouw ongeëvenaarde kennis en ervaring op het terrein van de Kwaliteit van Zorg, nationaal zowel als internationaal, resulteerde voor mij in een solide, inspirerende leerschool in het analyseren en structureel beschrijven van de soms weerbarstige onderzoekswerkelijkheid.
Als innemende 'éminence grise', wist je zonder enige vorm van hiërarchie de kernboodschap op subtiele wijze op de juiste plek te laten aankomen. Je toonde mij het ware 'hoogleraarschap' en dat heb ik als zeer waardevol ervaren. De respectvolle samenwerking tussen interdisciplinaire researchgroepen onder de ervaren vleugels van Fons Plasschaert en Richard Grol was een ode aan het in teamverband uitvoeren van wetenschappelijk onderzoek!

Emiel Verdonschot die de belangstelling voor de praktijkgerichte wetenschap verder bij me heeft aangewakkerd, dank ik voor het eerste jaar begeleiding. Miel, ik denk met veel genoegen terug aan de onderhoudende discussies over diagnostiek en over zinvolle en doorgeschoten zorg in de tandheelkunde. De lijntjes tussen ons waren kort en effectief; vaak overlegden we in de deur staand die onze kamers verbond.
Jouw plaats werd in 2004 ingenomen door **Michel Wensing**, werkzaam bij de WOK. Michel, in het begin moest je ongetwijfeld wennen aan de vaak directe werkwijze, tandartsen eigen. Je hebt me vooral het belang leren inzien om tot de kern door te dringen en niet teveel zijpaden tegelijk te bewandelen. Op cruciale momenten deed ik nooit tevergeefs een beroep op je; er was altijd wel een plek open voor een korte afstemming. Je rustige, contemplatieve uitstraling werkte zalvend op mijn soms wat ongedurige natuur. Vooruitkijkend naar de implementatie van innovaties in de tandheelkunde, hoop ik van harte dat we samen verdere onderzoeksuitdagingen kunnen ontplooien.
Vanaf de eerste dag in 1998 was **Wil van der Sanden** mijn collega in onderzoek. Tja, Wil, samen 20 jaar onderzoekservaring, samen 55 jaar praktijkervaring: we weten waar we het over hebben op het grensvlak van de wetenschap en de praktijk van alledag. Wil, humor was de kurk waar onze werkrelatie op dreef. Je kritische inzet en morele ondersteuning in deze voor ons tweede ronde - ook consequent voortgezet na het aanzienlijk toenemen van je onderwijstaken - zijn hartverwarmend en zij hebben zeer bijgedragen aan onze gezamenlijke publicaties. Het enige waar we enorm in verschillen is onze leeftijd, omdat jij stelselmatig je echte leeftijd met 5 jaar naar beneden blijft corrigeren!
Mieke Kwant dank ik voor haar geduld om de ironische humor, jarenlang in onze kamer verspreid, met ons te delen. Je toewijding aan je onderwijstaken binnen tandheelkunde heeft inspirerend op me gewerkt.
Marloes Nienhuijs en **Josef Bruers**, zijn mijn paranimfen en collega onderzoekers, die iedereen zich zou wensen gedurende een dergelijk traject. Marloes, je hebt met je jeugdige, aanstekelijke enthousiasme en subtiele humor de vele gezamenlijke uren, besteed aan het Cochrane literatuuroverzicht, tot een bijzondere beleving gemaakt. Het was een rijke ervaring, om als 'Melly' en 'Theodoor' het zoet van de uiteindelijke publicatie te mogen proeven.
Vele adequate adviezen, sympathieke relativeringen en gedegen kennis over tandheelkundige professionals kwamen van **Josef Bruers**, gepokt en gemazeld in het onderzoek naar wat tandartsen motiveert. Josef, 'jouw' NMT Peilstations zijn markant aanwezig in dit proefschrift, mede vanuit onze gezamenlijke drijfveer om het wetenschappelijk onderzoek en de praktijk elkaar te laten inspireren. Zonder reserve kon ik altijd een beroep op je doen; je innemende collegialiteit heeft veel voor mij betekend en ik zie uit naar verdere ontplooiing van onze werkrelatie.
Jan Mulder, **Henk Mokkink, Reinier Akkermans en Ewald Bronkhorst** vormen het illustere kwartet statistici, dat het onmogelijk geachte mogelijk maakte: door jullie heb ik mijn begrip, kennis en interesse voor dit onderdeel van wetenschapsbeoefening verder kunnen uitbreiden. Jan, hartelijk dank voor de leerzame woensdagmiddagen en vooral voor datgene wat

ik meenam naar mijn kamer: stapels papier die mijn deel werden na de analyses van de consensusbijeenkomsten. Henk, je gedegen kennis en ervaring van het eerstelijns geneeskundig onderzoek en de boeiende 'zelfregistratie'-sessies op de Kapittelweg zijn voor mij de krenten in de onderzoekspap geweest, toch niet onbeduidend voor onze 'havermoutgeneratie'!
Reinier, veel dank voor je bereidheid om snel en adequaat in te springen in een 'onbekend' project buiten de muren van je eigen afdeling.
Ewald, jij als 'statistisch geweten' van tandheelkunde, je moest dan toch met 'die Brabander' aan de slag. De doeltreffende analyses van de klinische trial werden gelardeerd met ogenschijnlijk speelse manoeuvres op je duo beeldschermen, waarbij de statistische materie over en weer vloog; en, zonder dat ik het spoor bijster raakte; dat was jouw verdienste.
Leontien van Eeten-Kruiskamp, bijna 1 jaar onderdeel van de projectgroep, stond met mij aan de wieg van de ontwikkelde patiënt risicoprofielen. Leontien, gezamenlijk trokken we met camera en instelapparatuur hele middagen de (poli)-kliniek in om mondopnamen te maken en uit te werken voor de online-consensusprocedure. Je innemende aanpak en consciëntieuze uitwerking droegen nadrukkelijk bij aan de kwaliteit van het materiaal voor de expertgroepen.
Het hoofd en alle medewerkers van de afdeling Preventieve en Curatieve Tandheelkunde dank ik voor de samenwerking. Dit type wetenschapbeoefening was niet voor iedereen direct herkenbaar. Ik heb vanaf het begin, tussen de uiteenlopende disciplines en karakters van de afdeling, het werk in jullie omgeving altijd uitdagend gevonden.
Speciale dank gaat hierbij uit naar **Marianne de Kluis-Helsper**, voor haar zorgzame adviezen en pragmatische oplossingen als het op de onvermijdelijke budgetperikelen aankwam. Marianne, je oogje in het zeil naar het wel en wee van dit project waren een gedegen steun in de rug.
Francis Ligterink en **Marieke Cornelisse**, ik bewonder jullie, vooral omdat het secretariaat een soort marktplaats is waar iedereen onaangekondigd kan binnenlopen om zijn eigen waar te verkopen. Je moet uit het goede hout gesneden zijn om daar professioneel mee om te gaan, iets dat jullie uitermate goed afging wanneer ik wat te dwingend, onder tijdsdruk, een beroep op jullie deed.
Harry Hoogenboom, de stille kracht! Harry, de ontspannende 'Heyendaal' lunchwandelingen reflecterend over de gewone mensen en de dingen die voorbij gaan zijn goede herinneringen! Je was in de eindfase mijn deskundige anker op weg naar de drukpers. Harry, er was druk op de ketel, maar je collegialiteit leed daar nooit onder.
Zowel op de afdeling als later bij het PAO-Tandheelkunde, was **Ans Giesbertz** voor dit project eveneens een belangrijke steunpilaar. Als er, meestal op korte termijn, gezorgd moest worden voor professionele ondersteuning of het verzorgen van gelikte documenten, wist ik dat ik bij je terecht kon. Ans, het symposium in het najaar 2007 was mede door jouw professionele aanpak een succes!
Als buitenpromovendus van de WOK, kwam ik bij **Jolanda van Haren** binnen op het secretariaat voor de lijntjes naar de drukbezette agenda's van Richard Grol en Michel Wensing. Jolanda, het 'Daar heb je hem weer' is me dierbaar in de oren gaan klinken! Vooral om de innemende manier waarop je me vervolgens de weg wees. **Janine Liefers** dank ik voor haar

adviezen bij het ontwerpen en verwerken van de Teleform formulieren die essentieel waren voor de praktijkregistraties in de tandartspraktijken.
Dit onderzoeksproject was nooit voldragen geworden zonder de inzet en motivatie van meer dan **100 collega tandartsen** die belangeloos hun professionele kennis en ervaring ter beschikking hebben gesteld. Ik ben hen allen zeer veel dank verschuldigd! Allereerst, de 31 tandartsen die actief zijn geweest in de twee expertgroepen voor het ontwikkelen van de klinische praktijkrichtlijn en de risicoprofielen. Over een periode van bijna 1 jaar, hebben zij ongeveer 10 uur belangeloos de klinische expertise aangeleverd zonder welke de ontwikkeling van de 19 risicoprofielen onmogelijk was geweest. Onder de deskundige leiding van **Ab Heyboer** en **Rob Burgersdijk** werden de afrondende consensusbijeenkomsten glansrijk afgesloten.
De landelijke richtlijncommissie Periodiek Mondonderzoek (PMO), bestaande uit 14 leden vanuit verschillende deelgebieden van de tandheelkunde, heeft tijd noch moeite gespaard om het 'blauwe' boekje, in elektronische versie achter in dit proefschrift, tot een uitdagend en leesbaar document te maken.
Ik beschouw de collega tandartsen (8 IQual groepen) en hun medewerkers, deelnemers aan de klinische trial, als de landelijke 'pioniers' van het praktijkgericht tandheelkundig onderzoek. Ze waren bereid de praktijkdeuren gedurende 9 maanden open te zetten voor wetenschappelijk onderzoek. De coördinatoren van deze groepen waren voor mij in de communicatielijnen naar de individuele praktijken toe essentieel voor de dataverzameling en goede verloop van de implementatiestudie. **Frans Korsten, Jan ten Bruggencate, Marjolein Alberga-Bakker, Wessel van Soest, Theo Goedendorp, Giets Ruigenwaard, Douwe Dijkstra en Frank Rademakers**, ik zal jullie betrokkenheid en collegialiteit blijven koesteren!
Ik dank de leden van de manuscriptcommissie voor de bereidheid het manuscript kritisch te beoordelen en de weg naar de finale, de openbare verdediging, voor me te openen.

Maar ook, de 'ridders van Elegast', die bij nacht en ontij hun huizen openstelden voor een verdwaalde mederidder uit vroeger tijden, op zoek naar een slaapplaats in den vreemde! **Fons en Mia Vullinghs** en **Wim en Paula Heijltjes,** jullie vriendschap en gastvrijheid waren ridderlijk!

Charlotte, mijn levensmaatje, nimmer heb je dit avontuur ook maar met één kritische kanttekening omlijst. Je wist dat het onbegonnen werk was, als je het al hebt overwogen. Twee professionele levens geboetseerd rondom de preventieve zorgverlening, het heeft ons voortdurend geïnspireerd en blijvend gevormd. De weg naar de realisatie van dit proefschrift is mede geplaveid met jouw professionele opvattingen en stimulerende belangstelling. Iets minder wekkers op nocturne momenten, iets minder geschipper met de auto, zeker een PC ontwenningskuur, zeker meer tijd voor onze kinderen, muziek en theater.
Maar nu eerst het slotakkoord, mag ik deze dans van je?

Curriculum Vitae

Curriculum Vitae

Dirk Mettes werd op 22 maart 1948 geboren in Valkenswaard, waar hij in 1966 eindexamen HBS-B deed aan het Hertog Jan College. Van 1966 tot 1972 volgde hij de opleiding tot tandarts aan de Katholieke Universiteit te Nijmegen. Tussen 1972 en 1974 diende hij een jaar als dienstplichtig tandarts bij de Koninklijke Landmacht in Ede, nam hij waar in tandartspraktijken in Arnhem, Bergeijk, Eersel en Zwolle, en werkte bij de Diensten van Jeugdtandverzorging in Eindhoven en het Land van Heusden en Altena. In 1974 vestigde hij zich als tandarts in een groepspraktijk te Boxtel.
Tussen 1974 en 1992 was hij actief betrokken bij de oprichting van de Stichting Gezondheidsvoorlichting en - Opvoeding (GVO) Boxtel, Esch en Liempde, en bij regionale activiteiten van de Nederlandse Maatschappij tot Bevordering der Tandheelkunde (NMT). Daarin was hij actief bij de organisatie van bij- en nascholing en het Regionaal Overleg Collectieve Preventie; daarnaast was hij voorzitter van het Afdelingsbestuur 's- Hertogenbosch e.o. Verder vervulde hij diverse functies in landelijke NMT commissies (Interne en Externe Communicatie, Scholing en Kwaliteit en Praktijkrichtlijnen) en was hij tussen 1996 en 2006 actief als voorzitter van de Redactieraad respectievelijk als bestuurslid van het Ivoren Kruis.

De sluimerende belangstelling voor het werken op het grensvlak van wetenschap en praktijk kreeg in 1998 vorm door een deeltijdfunctie aan het UMC St. Radboud als projectgroeplid bij het onderzoek naar klinische praktijkrichtlijnen in de tandheelkunde. In mei 2003 startte hij in deeltijd zijn promotieonderzoek, een samenwerking tussen de afdelingen Preventieve en Curatieve Tandheelkunde (PCT) en Centre of Quality of Care Research (WOK).
Gedurende het promotietraject volgde hij postacademische cursussen m.b.t. Systematische review (EMGO), Evidence-based dentistry (Oxford University, UK) en Evidence-based medicine (Dutch Cochrane Centre). Sinds 2003, is hij voorzitter van de Commissie Onderzoeksbegeleiding (COB) van de beroepsorganisatie NMT. Twee dagen per week is hij als tandarts werkzaam in de algemene praktijk te Boxtel.

Dirk Mettes is getrouwd met Charlotte Kroese, sociaal geneeskundige/jeugdgezondheidszorg, werkzaam als stafarts bij Vivent te 's-Hertogenbosch. Ze hebben drie kinderen: Tijs, Sander en Charlotte.